Geotechnical Engineering Report

Temple at the Nielson Site
Cody, Wyoming
August 18, 2022
Terracon Project No. 26225020

Prepared for:
DJ&A PC
Missoula, Montana

Prepared by:
Terracon Consultants, Inc.
Great Falls, Montana

August 18, 2022

Terracon GeoReport

DJ&A PC
2000 Maple Street
Missoula, Montana 59808

Attn: Mr. Christopher Anderson, P.E. – President/CEO
P: (406) 721-4321
E: chris@djanda.com

Re: Geotechnical Engineering Report
Temple at the Nielson Site
Skyline Drive
Cody, Wyoming
Terracon Project No. 26225020

Dear Mr. Anderson:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with the revised Terracon Proposal No. PC4225017 dated March 14, 2022, and subsequent signed Agreement for Services dated April 7, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Matthew D. Hoffmann, P.E.
Office Manager

Professional Engineer
GARY W. ROME
4749
Date 8/18/22
WYOMING

Gary Rome, P.E.
Senior Engineer

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

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INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed new Temple at the Nielson Site to be located at Skyline Drive in Cody, Wyoming. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Lateral earth pressures
- Frost considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC
- Pavement design and construction

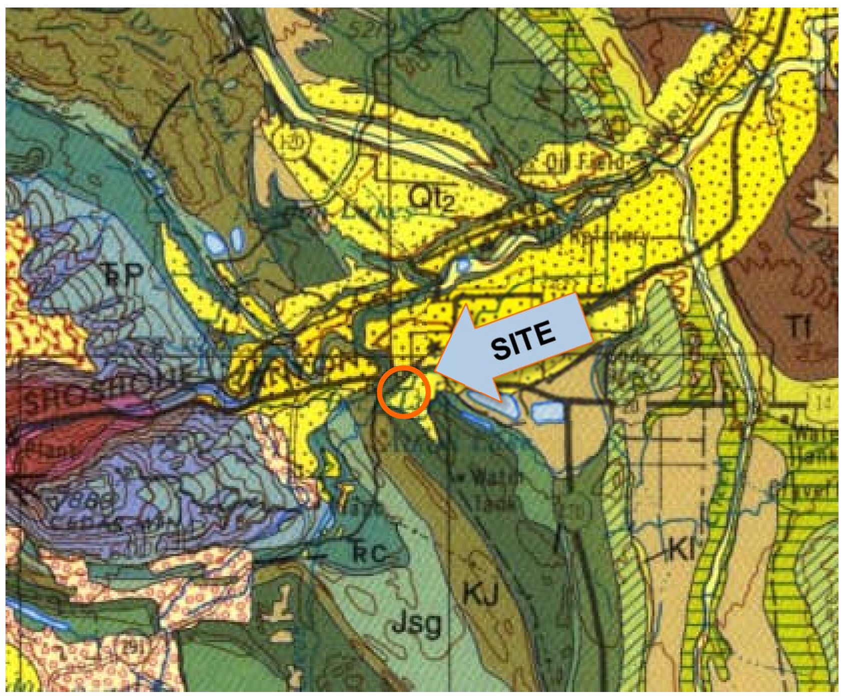
The geotechnical engineering Scope of Services for this project included the advancement of 12 test borings to depths ranging from approximately 3.9 to 70.0 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located north of the intersection of Skyline Drive with the Cody Canal in Cody, Wyoming Approximate GPS Coordinates: 44.5119 °N, 109.0819° W See **Site Location**
Existing Improvements	Undeveloped land

Item	Description
Current Ground Cover	Native grasses and isolated areas of bare soil
Existing Topography	The site is situated on a bluff or terrace area with a slight slope along the top of the bluff from south, near Elevation 5142 feet above mean sea level (MSL), toward the north-northeast with a maximum drop of approximately 7 feet based on site specific topographic survey information provided by DJ&A. The north and west sides of the parcel are elevated above low-lying drainage areas feeding Sulfur Creek to the north of the site. The bluff is situated approximately 45 to 90 feet above the low-lying areas to the west and north.
Geology	The site geologic conditions consist primarily of medium dense to very dense alluvial gravel terrace deposits with varying amounts of silt and sand. These deposits are underlain by Cretaceous Age interbedded sandstone and claystone bedrock with historically reported bentonite beds anticipated within the variegated claystone.  **Figure 1: Excerpt from Geologic Map of the Cody 1° x 2° Quadrangle, Northwestern Wyoming (compiled by William G. Pierce, 1997)**

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

The final layout of the site development shift from Concept C layout to currently planned Concept G layout which included rotation and a slight shift west of the temple structure, along with shifting the auxiliary building from the west edge of the parking area to the southwest portion of the site and the utility building from the west edge of the site to the northwest portion of the site. Additionally, the surrounding minor subdivision lots were adjusted in size and layout, along with the access road and cul-de-sac extending further to the west and north through the property.

Item	Description
Information Provided	During proposal development we were provided a Google Earth .kmz file showing the projected boundary of the 7.68-acre site to be developed, with approximately 4.69 acres for the Temple site development. We were subsequently provided with the final concept layout along with a topographic site map by DJ&A. All correspondences have been through DJ&A via email.
Project Description	We understand the confidential project is to include the proposed construction of a Temple site (designated 1-40E) for the Church of Jesus Christ of Latter-day Saints along with associated parking and landscaping at the site. The development will include auxiliary and utility buildings located on the property as noted above.
Proposed Structures	It is assumed that proposed Temple with an approximate footprint on the order of 40,000 square feet is to be single-story wood-framed, or light gauge steel construction with brick/masonry veneer. Shallow, frost-depth footings, stem wall, and slab-on-grade construction is assumed.
Finished Floor Elevation	Not provided at the time of report preparation; however, assumed to be within approximately 1 to 2 feet of existing site grade.
Maximum Loads (assumed by Terracon)	■ Wall loads – 4,500 to 7,500 pounds per lineal foot (pfl) ■ Column loads – 75 to 200 kips ■ Slab loads – 250 pounds per square foot (psf)
Grading/Slopes	Based on topographic data, it appears that minor grading on the order of 2 to 4 feet will be required to develop final grade at the site. Final slope angles of as steep as 5H:1V (Horizontal: Vertical) surrounding pavement and structures are expected.
Below-Grade Structures	None anticipated
Free-Standing Retaining Walls	Retaining walls are not expected to be constructed as part of the site development to achieve final grades.

Item	Description
Pavements	Paved driveway and parking will be constructed on approximately 1.5 acres of the Temple Area of the parcel. We anticipate that the pavement will generally support passenger vehicles with periodic service trucks. Based on The Church's requirements for new construction of parking lots, we assume the following traffic loading: ■ Parking: Six 18-kip ESALs per week ■ Driveways: Fifteen 18-kip ESALs per week ■ Trash Enclosure Approach Slab: One 40-kip axle load per week Traffic Analysis Period: Asphaltic Concrete Pavement: 40 years
Estimated Start of Construction	2023

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Upper Gravel**	Well-Graded GRAVEL with Silt and Sand, fine grained, subangular, light brown, dry, medium dense
2	**Lower Gravel**	Poorly-Graded GRAVEL with Silt and Sand, coarse grained, subrounded, light brown to gray, dry, dense to very dense, some cobbles
3	**Clay**	Lean Clay with Gravel, low plasticity, dark brown, moist, stiff
4	**Bedrock**	Claystone, maroon, moist, fine-grained, moderately fractured, thin bedding, highly weathered, weak rock, interbedded sandstone layer

The borings were observed while drilling and immediately after completion for the presence and level of groundwater. Groundwater was not observed in any of the borings. The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation. Therefore, groundwater levels during construction or at other times in the life of the structure may vary from the conditions indicated on the Logs.

GEOTECHNICAL OVERVIEW

A geotechnical exploration has been performed for the proposed new Temple at the Nielson Site in Cody, Wyoming. A total of 12 borings were drilled to depths ranging between 3.8 to 6.5 feet below existing grade for pavements, 10.3 to 20.8 feet below existing grade for the building, and 70 below existing grade for evaluation of the north property slope. This report addresses the geotechnical recommendations for foundations along with earthwork portions and pavement construction for the project.

The project site generally consists of soft to medium stiff, high plasticity fat clay. The soil profiles are presented in further detail on the attached GeoModel, which can be found in the **Figures** section of the report, along with on the individual Boring Logs within the **Exploration Results** section of this report.

The near surface soils consist primarily of gravels, with an area of lean clay with gravel located along the eastern portion of the site. These clay soils, where encountered, could become unstable with typical earthwork and construction traffic, especially after precipitation events. The establishment of effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The soils which form the bearing stratum for shallow foundations are medium dense to very dense alluvial terrace gravel deposits, which provide reliable support with limited potential for differential settlement when properly prepared. The **Shallow Foundations** section addresses support of the building bearing on properly prepared native granular soils. The **Floor Slabs** section addresses slab-on-grade support of the building.

Both flexible and rigid (for dumpster pad) pavement systems are recommended for this site. The **Pavements** section addresses the design of pavement systems.

Based on preliminary review of available aerial imagery, past slope instabilities appear to have occurred at the northern portion of the site. An obvious past slope failure lobe, generally moving in the direction of Sulfur Creek from the bluff site, was noted in this review, and Boring DH-1 was advanced adjacent to this area to further evaluation of slope stability be included in the current scope of development. Based on subsurface conditions encountered consisting of medium dense to very dense gravel deposits overlying interbedded claystone and sandstone bedrock, global stability of the slope is not of concern, further discussion on our slope stability evaluation is presented in the **Slope Stability** section.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, existing vegetation, root mat, and existing fill should be removed. Complete stripping of these materials should be performed in the proposed building and parking/driveway areas.

For foundations, excavations should be conducted to base of footing elevation, at which elevation native gravel subgrade should be moisture conditioned and compacted to a minimum of 98 percent of the maximum laboratory dry density per ASTM D698 prior to placement of foundation concrete.

After removal of vegetation and or any unsuitable materials, the pavement subgrade areas should be scarified to a depth of 12 inches and recompacted to 95 percent of the maximum dry density per ASTM D698 to improve loose or soft areas. After scarifying and re-compacting, the pavement subgrade should be subsequently proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck with a minimum weight of 20 tons and tire pressures on the order of 90 psi. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting, yielding, pumping, or rutting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Interior slabs-on-grade should be prepared in accordance with the **Floor Slabs** section recommendations subsequently discussed within this report. Exterior slabs-on-grade (flatwork) should be prepared consistent with pavement subgrade as discussed above.

Fill Material Types

Fill required to achieve design grade should be classified as Structural Fill, Select Fill, and General Fill. Structural Fill (if required) is material used below foundations, or within 5 feet horizontally of structures, or pavements. Select Fill is optional material for use from native prepared subgrade to within 6 inches of base of interior floor slabs, where the use of Structural Fill gradations is not strictly required. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements:

Material Type [1]	USCS Classification	Acceptable Location for Placement
Structural Fill[2] (imported material)	GW, GP, SW, SP, and dual (GM/SM) symbols	Below foundation elevation, below slab areas, and as replacement backfill
Select Fill[3] (sub-slab areas above footing elevation)	GW, GP, SW, SP and dual (GM/SM) symbols	Below slab areas, interior utility trench backfill, above foundation/footing elevation (option to replacement using Structural Fill)
Crushed Base Course	1 ½ inch minus, Wyoming Public Works Standard Specifications (WPWSS) Section 02190, Grading W	Leveling course below slab above Structural or Select Fill, and as crushed aggregate base course for pavements
General Fill [4]	ML, CL, CL-ML, SM, SP	The on-site gravels and lean clay with gravel soils appear suitable for use as General Fill, including site grade raising material, site (exterior) utility trench backfill, and exterior backfill of foundations.
Non-Frost Susceptible Fill (NFS) [5]	GC, GP, GC-GM, GP-GM	Below exterior flatwork critical to project to mitigate frost-action

1. Structural, Select, and General Fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Structural Fill, defined as imported aggregate, should meet the following criteria outlined below:

Gradation	Percent Finer By Weigh (ASTM C136)
1 ½”	100
No. 4	30-60
No. 200	12 (max)
Liquid Limit	25 (max)
Plastic Index	10 (max)

3. Select Fill, defined as imported aggregate, should meet the following criteria outlined below:

Gradation	Percent Finer By Weigh (ASTM C136)
3”	100
No. 4	80
No. 40	35
No. 200	15 (max)
Liquid Limit	30 (max)
Plastic Index	10 (max)

4. Significant moisture conditioning of the native clay may be necessary to meet compaction requirements; this will require mechanical reduction in clay clod size (i.e. disking, etc.) to a maximum 1-inch dimension to facilitate moisture conditioning; the necessary moisture adjustment will be difficult during wet/cold seasons.
5. Non-Frost Susceptible Fill should have no more than 5 percent passing the No. 200 sieve

Fill Compaction Requirements

Structural, Select, and General fill should meet the following compaction requirements.

Item	Structural Fill	Select Fill	General Fill
Maximum Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as Structural Fill	Same as Structural Fill

Item	Structural Fill	Select Fill	General Fill
Minimum Compaction Requirements [1, 2]	98% of max. below foundations, interior floor slabs, and interior backfill (including building utility trench backfill) 95% of max. above foundations, exterior backfill, and below pavements City Street requirements change to 95% of max. as determined by modified Proctor test (AASHTO T180) for base course and 90% for subbase course	98% of max. below floor slabs	92% of max. in green areas 95% of max. in paved areas, including site (exterior) utility trench backfill
Water Content Range [1]	Low plasticity cohesive: -2% to +3% of optimum Granular: -3% to +3% of optimum	Granular: -3% to +3% of optimum	As required to achieve min. compaction requirements

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison using local practices may be more appropriate. It should be noted that ASTM D698 allows for rock-correction of samples with up to 30% Retained on the 3/4" screen.

Utility Trench Backfill

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for Structural Fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that provide positive discharge beyond the backfill zones, such as onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of existing topsoil, root mat and other deleterious materials, foundation subgrade preparation, and mitigation of areas delineated to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content. Based on the planned foundation and pavement construction it is recommended that frequencies as below be utilized:

- Minimum of one test per isolated (spread) footing, for each lift

- Minimum 1 test per 75 feet of backfill per lift of foundation backfill
- Minimum of one test for every 2,500 square feet of compacted fill in the building areas
- Minimum one test per 5,000 square feet of pavement subgrade and base course, per lift
- Minimum one test per lift off compacted utility trench plug

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

The primary geotechnical consideration for the Temple site is to provide uniform bearing within the native gravel while limiting potential for differential settlement. To accomplish this, proper preparation of the native gravel subgrade in accordance with the requirements noted in **Earthwork** is critical to limiting differential movement, as the gravel soils provide substantial bearing capacity for the type of building construction planned. The following design parameters are applicable for shallow foundations if the requirements of the **Earthwork** section are adhered to.

Design Parameters – Compressive Loads

Item	Description
Maximum Allowable Bearing pressure [1, 2]	3,500 psf
Required Bearing Stratum [3]	Properly prepared native gravel, or Structural Fill replacement fill
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Ultimate Passive Resistance [4] **(equivalent fluid pressures)**	190 pcf (cohesive backfill) 460 pcf (granular backfill)
Ultimate Coefficient of Sliding Friction [5]	0.60 (granular material)
Minimum Embedment below Finished Grade [6]	Exterior footings in unheated areas: 48 inches Interior footings in heated areas: 18 inches

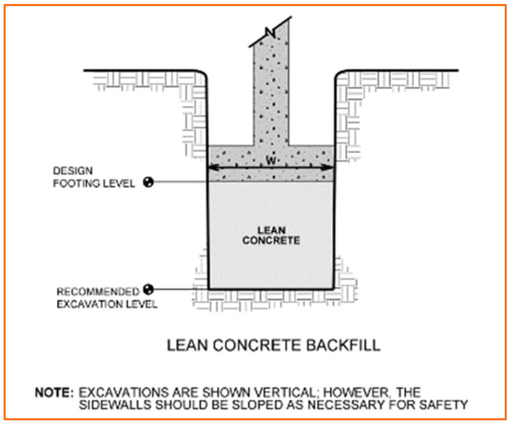
Item	Description
Estimated Total Settlement from Structural Loads [2]	Less than about ¾ inch
Estimated Differential Settlement [2, 7]	About ½ to $^2/_3$ of total settlement

1. Assumes proper preparation of bearing surface in accordance with **Site Preparation**. Based on a minimum factor of safety of 3.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. A minimum factory of safety of 2 should be applied to ultimate values.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure, also application of a minimum factor of safety of 2 should be utilized.
7. Differential settlement and resultant deflection profile are as estimated for given column spacing or a maximum spacing of 50 feet.

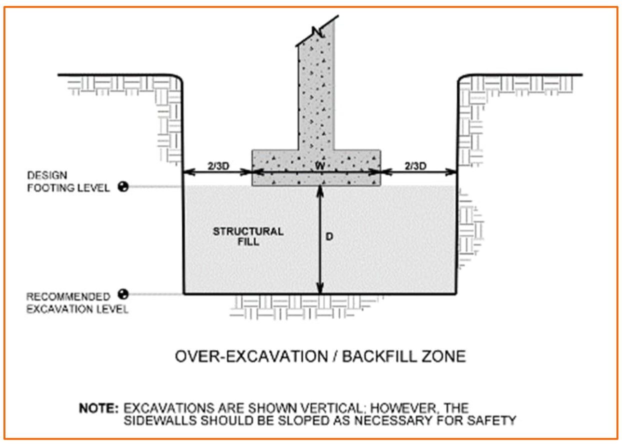
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with Structural Fill placed, as recommended in the **Earthwork** section.



SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil/bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**. Subsurface explorations at this site were extended to a maximum depth of 70 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Properly prepared native gravel or Select/Structural Fill replacement material below a minimum of 6 inches of crushed base course
Estimated Modulus of Subgrade Reaction [2]	250 pounds per square inch per inch (psi/in) for point loads

1. Crushed aggregate base course in accordance with Wyoming Public Work Standard Specifications, Section 02190, Grading W.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

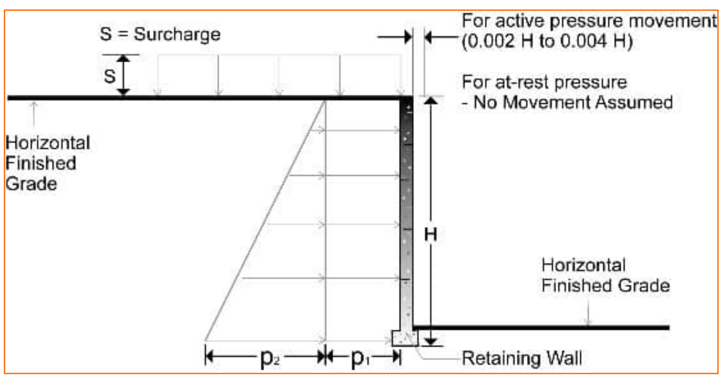
Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Structural Fill - 0.26	35	(0.26)S	(35)H
	Native Gravel – 0.28	40	(0.28)S	(40)H
	Native Clay – 0.59	65	(0.59)S	(65)H
At-Rest (Ko)	Structural Fill - 0.42	55	(0.42)S	(55)H
	Native Gravel – 0.44	60	(0.44)S	(60)H
	Native Clay – 0.74	80	(0.74)S	(80)H
Passive (Kp)	Structural Fill - 3.8	500	---	---
	Native Gravel – 3.5	460	---	---
	Native Clay – 1.7	190	---	---

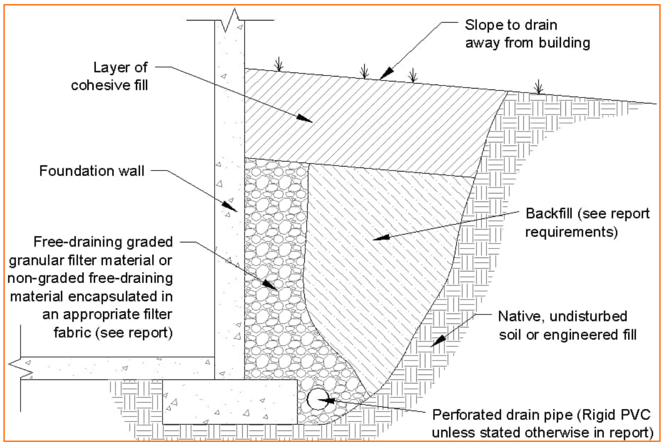
Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 110 pcf (native clay soils), 130 pcf (native gravel soils) 135 pcf (Structural Fill)
- Backfill placed in horizontal lifts and compacted between 95 and 98 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment is not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5 percent passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



PAVEMENTS

General Pavement Comments

The pavement section recommendations provided are based on the subsurface profile and laboratory testing of bulk samples obtained from the subgrade encountered during our field exploration. Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section. The pavement section recommendations provided below are suitable for traffic support as discussed within each section upon the fully constructed pavement section. These sections, or portions of the constructed section, have not been designed to support channelized and high-intensity traffic loading associated with construction traffic such as concrete trucks for placements, aggregate or asphalt haul trucks.

Pavement Design Parameters

Designs for minimum thicknesses for new pavement sections for this project have been based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of subgrade soils. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade.

To analyze pavement subgrade support, a composite bulk sample was obtained throughout the anticipated pavement areas. The controlling subgrade material (alluvial deposits, generally classified as clayey sand with gravel) was collected and laboratory-soaked CBR performed at a single point condition. The single point soaked California Bearing Ratio (CBR) condition resulted in a value of 8.0 for the controlling subgrade which was utilized in the analysis discussed below.

Our analysis has been conducted assuming the minimum required traffic based on The Church's requirements for new construction of parking lots. We expect that primary traffic will consist of passenger vehicles with substantial personal auto/light trucks along with limited daily light delivery vehicles (FedEx, UPS, similar) and with weekly trash collection. We have assumed that the combined traffic can be considered in two scenarios, Light Duty for parking and areas of limited traffic and Medium Duty for areas of more substantial drive lane traffic. For these cases we have assumed a total load coverage equivalent of approximately six weekly 18-kip single axle loads (ESALs) for Light Duty and 15 weekly ESALs for Medium Duty. Based on these assumptions, an estimated 30,000 ESALs represent the design traffic intensity for Light Duty pavements and an estimated 60,000 ESALs represent the design traffic intensity for Medium Duty pavements over an approximate 40-year design period. For analysis an initial serviceability index of 4.2, a terminal serviceability index of 2.0, standard deviation of 0.45, and reliability of 90 percent have been utilized for section thickness development.

A modulus of subgrade reaction of about 150 pci was used for the PCC pavement designs. The values were based upon the controlling CBR value of 8.0 and correlated to k-value for rigid pavement design based on published data and our experience with the clayey sand subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A modulus of rupture of 580 psi was used for pavement concrete.

Pavement Subgrade Preparation

For all areas to receive new asphalt pavement sections, we recommended that the upper 12 inches of the subgrade be scarified, moisture conditioned and compacted to 95 percent of the maximum laboratory dry density value in accordance with ASTM D698 prior to placement of pavement section components. The subgrade should be evaluated and testing for compliance with these conditions within 24 hours of commencement of pavement operations to ensure that the moisture content and density values are within recommended ranges. Areas not in compliance should be moisture conditioned and recompacted. Areas where unsuitable conditions (as delineated by proof-rolling subsequent compaction testing) are located should be repaired either by reworking the existing soil or removing and replacing the soil with properly compacted fills. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by a qualified individual immediately prior to placement of base course. The subgrade should be in its finished form at the time of the final review.

Pavement Section Thicknesses

The listed pavement component thicknesses should be used as a guide for pavement systems at the site for the traffic classifications stated herein. These recommendations assume a 20-year pavement design life for new pavement and an estimated 10 years of additional life from a hot mix asphalt overlay of existing flexible pavement. If pavement frequencies or loads will be different than that specified Terracon should be contacted and allowed to review these pavement sections. The following table provides options for AC Sections:

Asphaltic Concrete Design			
Layer	Thickness (inches)		
	Light Duty [1]	Medium Duty [2]	Specifications
Subgrade	Upper 12 inches of existing soil	Upper 12 inches of existing soil	95% of maximum dry density per ASTM D698, +/-3% of Optimum Moisture Content (OMC)
Crushed Base Course	8	9	WPWSS, Section 02190, Grading W
Asphalt Concrete	3	4	WPWSS, Section 02510
Total Pavement Section	11	13	--

1. Light Duty Pavement was designed for a total of 30,000 ESALs.
2. Heavy Duty Pavement was designed for a total of 60,000 ESALs.

Rigid Pavement

We recommend that Portland cement concrete (PCC) pavement be utilized in entrance and exit sections, dumpster pads, and other areas where extensive wheel maneuvering is expected. Heavy duty pavement design for the apron was based on 60,000 ESALs. The recommended section is provided in the table below.

Portland Cement Concrete Pavement Design		
Layer	**Thickness (inches)**	**Specifications**
Subgrade	Upper 12 inches of existing soil	95% of maximum dry density per ASTM D698, +/-3% of Optimum Moisture Content (OMC)
Crushed Base Course	4	WPWSS, Section 02190, Grading W
PCC (reinforced)	6	WPWSS, Section 02520
Total Pavement Section	10	--

Although not required for structural support, the base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, joint faulting and subgrade "pumping" through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

The Portland cement concrete mix design should be designed with proper air-entrainment and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing. Adequate reinforcement and number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI requirements. The joints should be sealed as soon as possible (in accordance with the sealant manufacturer's instructions) to minimize infiltration of water into the soil.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

FROST CONSIDERATIONS

The gravel soils located on the site have limited frost susceptibility; however, the clay soils located near the east side of the site to depths between 1.5 and 2.0 feet below existing grade are frost susceptible. Where clay subgrades are encountered small amounts of water can affect the performance of the slabs on-grade, sidewalks, and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site storm drainage system.
- Install drains around the perimeter of the building, stoops, below exterior slabs and pavements, and connect them to the storm drainage system.
- Grade clayey subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system.
- Place NFS fill as backfill beneath slabs and pavements critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material.

SLOPE STABILITY

Mechanics of Stability

Slope stability analyses take into consideration material strength, presence and orientation of weak layers, water (piezometric) pressures, surcharge loads, and the slope geometry. Mathematical computations are performed using computer-assisted simulations to calculate a Factor of Safety (FS). Minor changes to slope geometry, surface water flow and/or groundwater levels could result in slope instability. Reasonable FS values are dependent upon the confidence in the parameters utilized in the analyses performed, among other factors related to the project itself.

Geometric Analysis Results

Slope stability analyses were performed for the cross-section geometries interpolated from topographic data provided by DJ&A on the Skyline Drive, Cody Wyoming – Site Map dated 8/2/2022. Parameters for the analyses were derived from our exploratory borings, experience, and laboratory tests. Stability analyses were conducted using the computer program GEOSTASE developed by Gregory Geotechnical.

Unstable or Potentially Unstable Slopes

Based on the results of our field investigation, laboratory testing program, and geotechnical analysis, development of the site is considered feasible from a geotechnical viewpoint provided the conclusions and considerations provided herein are incorporated into the design and construction of the project.

The stability of the slopes at the cross-section locations shown on the **Exploration Plan** were analyzed based on the provided topography, soil properties derived from our geotechnical exploration, laboratory test results and our experience with similar soil conditions. Soil and bedrock properties used in the analyses are shown below:

Material	Moist Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
Upper Gravel	125	0	32
Lower Gravel	130	0	36
Weathered Bedrock	140	1500	20

Based on the observations of past slope instability visible north of the property, failure mechanism appears to be circular failure surface developed within the overburden gravel materials. Therefore our analyses focused on circular failure surface development, the calculated FS for the critical surface identified in each section is shown below. The typically accepted minimum FS for long-term slope stability supporting improvements is 1.5 for static conditions and 1.3 for pseudo-static conditions. The slope stability results are included in the Figures Section of this report.

Cross-Section	Minimum Calculated Factor-of-Safety for Slopes	
	Overall Slope Circular Failure Surface	Localized Slope Circular Failure Surface[2]
A-A’ As Is	1.703	1.360
A-A’ As Is Seismic	1.352	1.093
A-A’ As Is With Water[1]	1.293	1.268
A-A’ As Is With Structure	1.703	1.360
A-A’ As Is With Seismic + Water	1.014	1.007

1. Ground water was not encountered within the exploration locations for this scope of services, a simulated water surface 7 feet below the existing grade was utilized to indicate potential effects of water surface development, and importance of limiting potential for surface water discharge from the developed site to the north slope.
2. Localized failure occurs within the upper gravel layer on the north slope surface, and do not extend onto the bluff where site is to be located. These indicate that some attritional wasting of the north slope may occur overtime under normal conditions but would be exasperated by water over time.

The minimum factor-of-safety for global stability at the cross section analyzed is greater than 1.5.

Surficial Slope Stability

Recent evidence of surface instability was not observed on the slopes adjacent to the proposed improvements during our site visits. As noted, evidence of past, dormant, slope movement can be seen from aerial imagery review, and was observed during site visit. Minor areas of erosion were observed. Surficial slope instability typically impacts the upper 3 to 5 feet of the subsurface profile, predominantly during extended wet periods. Regular maintenance should be anticipated to identify and address changes in natural drainage creating potential for soil creep or erosion near improvements. This includes replacing or replanting trees and grasses and grading the slope to reduce soil creep and erosion. If future surficial slope erosion occurs near the crest of slopes, we recommend the slope face be restored as soon as practical. We recommend irrigated landscaping be setback a minimum of 30 feet from the crest of the slopes. Also, it is recommended that surface water infiltration and discharge be directed away from the north portion of the site.

Fill slopes should be re-vegetated as soon as practicable after grading and protected from erosion until vegetation is established. Slope planting should consist of ground cover, shrubs, and trees possessing deep, dense root structures that require minimum irrigation. It is the responsibility of the owner to maintain such planting.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary					
Boring	**Sample Depth (feet)**	**Soil Description**	**Soluble Sulfate (%)**	**Electrical Resistivity (Ω-cm)**	**pH**
B-5	5.0 – 6.5	Well Graded Gravel with Silt and Sand (GW-GM)	0.0021	7,900	7.8
B-6	5.0 – 9.0	Poorly Graded Gravel with Silt and Sand (GP-GM)	0.0100	3,000	8.0
P-1	2.5 – 6.5	Well Graded Gravel with Silt and Sand (GW-GM)	0.0607	1,800	7.3

Results of water-soluble sulfate testing indicate that samples of the on-site soils have an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute (ACI) Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

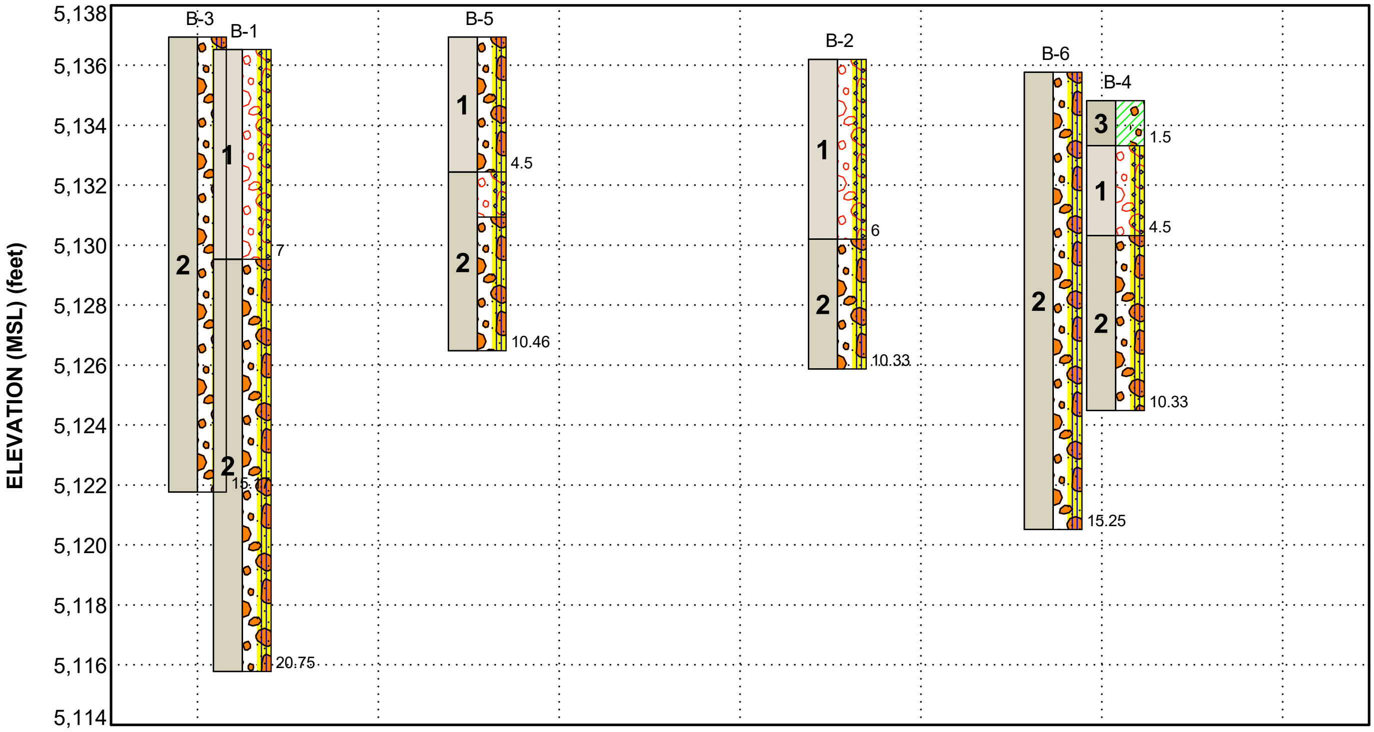
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL - BUILDING AREA

Nielson Site ■ Cody, WY
Terracon Project No. 26225020



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Upper Gravel	Well-Graded GRAVEL with Silt and Sand, fine grained, subangular, light brown, dry, medium dense
2	Lower Gravel	Poorly-Graded GRAVEL with Silt and Sand, coarse grained, subrounded, light brown to gray, dry, dense to very dense, some cobbles
3	Clay	Lean Clay with Gravel, low plasticity, dark brown, moist, stiff
4	Bedrock	Claystone, maroon, moist, fine-grained, moderately fractured, thin bedding, highly weathered, weak rock, interbedded sandstone layer

LEGEND

Well-graded Gravel with silt and sand

Poorly-graded Gravel with Silt and Sand

Lean Clay with Gravel

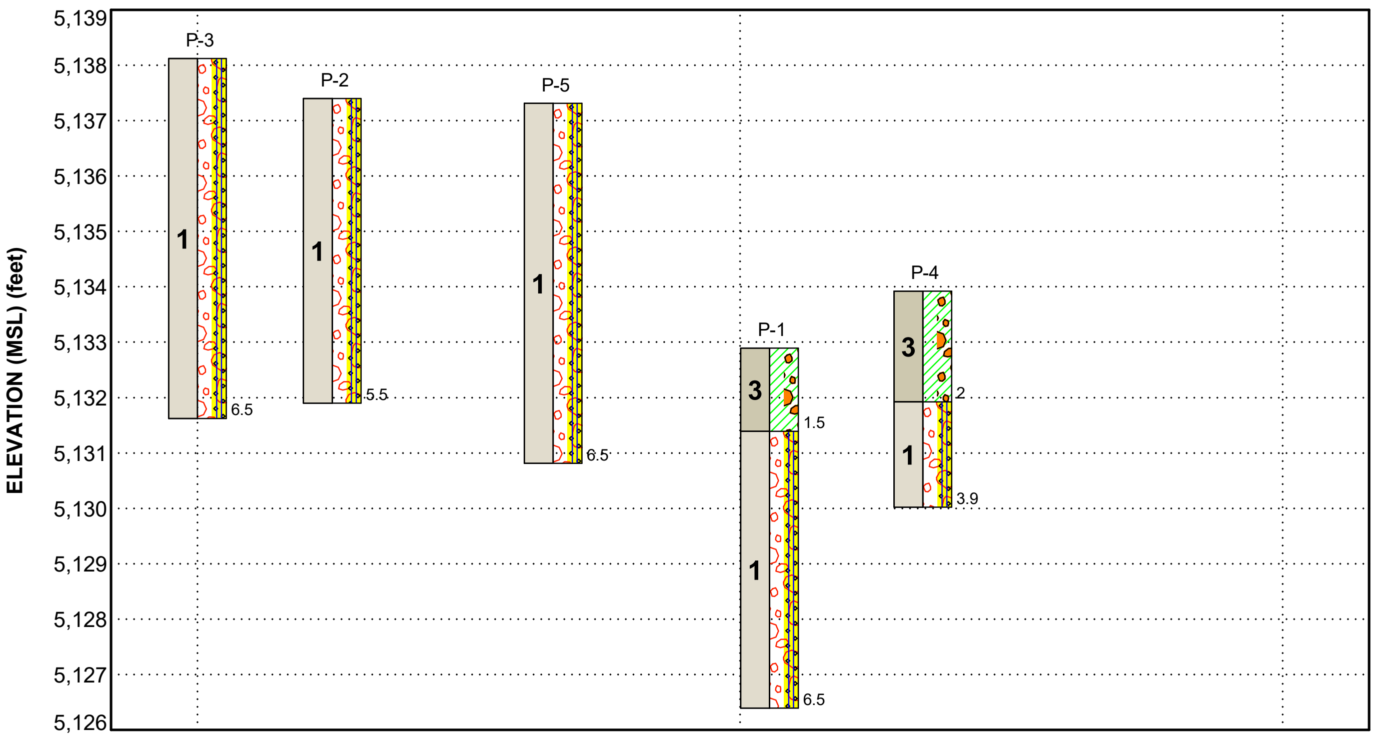
NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL - PAVEMENT AREAS

Nielson Site ■ Cody, WY
Terracon Project No. 26225020

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Upper Gravel	Well-Graded GRAVEL with Silt and Sand, fine grained, subangular, light brown, dry, medium dense
2	Lower Gravel	Poorly-Graded GRAVEL with Silt and Sand, coarse grained, subrounded, light brown to gray, dry, dense to very dense, some cobbles
3	Clay	Lean Clay with Gravel, low plasticity, dark brown, moist, stiff
4	Bedrock	Claystone, maroon, moist, fine-grained, moderately fractured, thin bedding, highly weathered, weak rock, interbedded sandstone layer

LEGEND

Lean Clay with Gravel

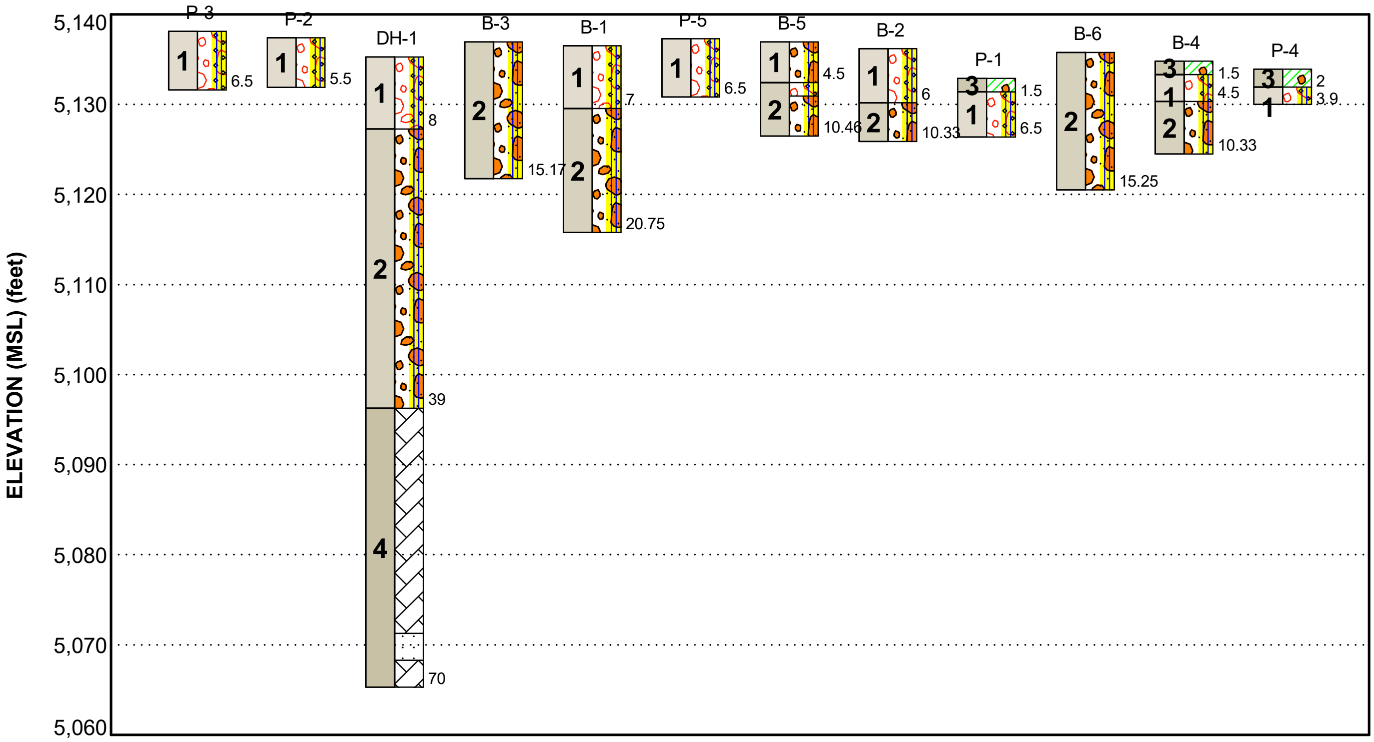
Well-graded Gravel with silt and sand

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GEOMODEL - FULL SITE

Nielson Site ■ Cody, WY
Terracon Project No. 26225020



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Upper Gravel	Well-Graded GRAVEL with Silt and Sand, fine grained, subangular, light brown, dry, medium dense
2	Lower Gravel	Poorly-Graded GRAVEL with Silt and Sand, coarse grained, subrounded, light brown to gray, dry, dense to very dense, some cobbles
3	Clay	Lean Clay with Gravel, low plasticity, dark brown, moist, stiff
4	Bedrock	Claystone, maroon, moist, fine-grained, moderately fractured, thin bedding, highly weathered, weak rock, interbedded sandstone layer

LEGEND

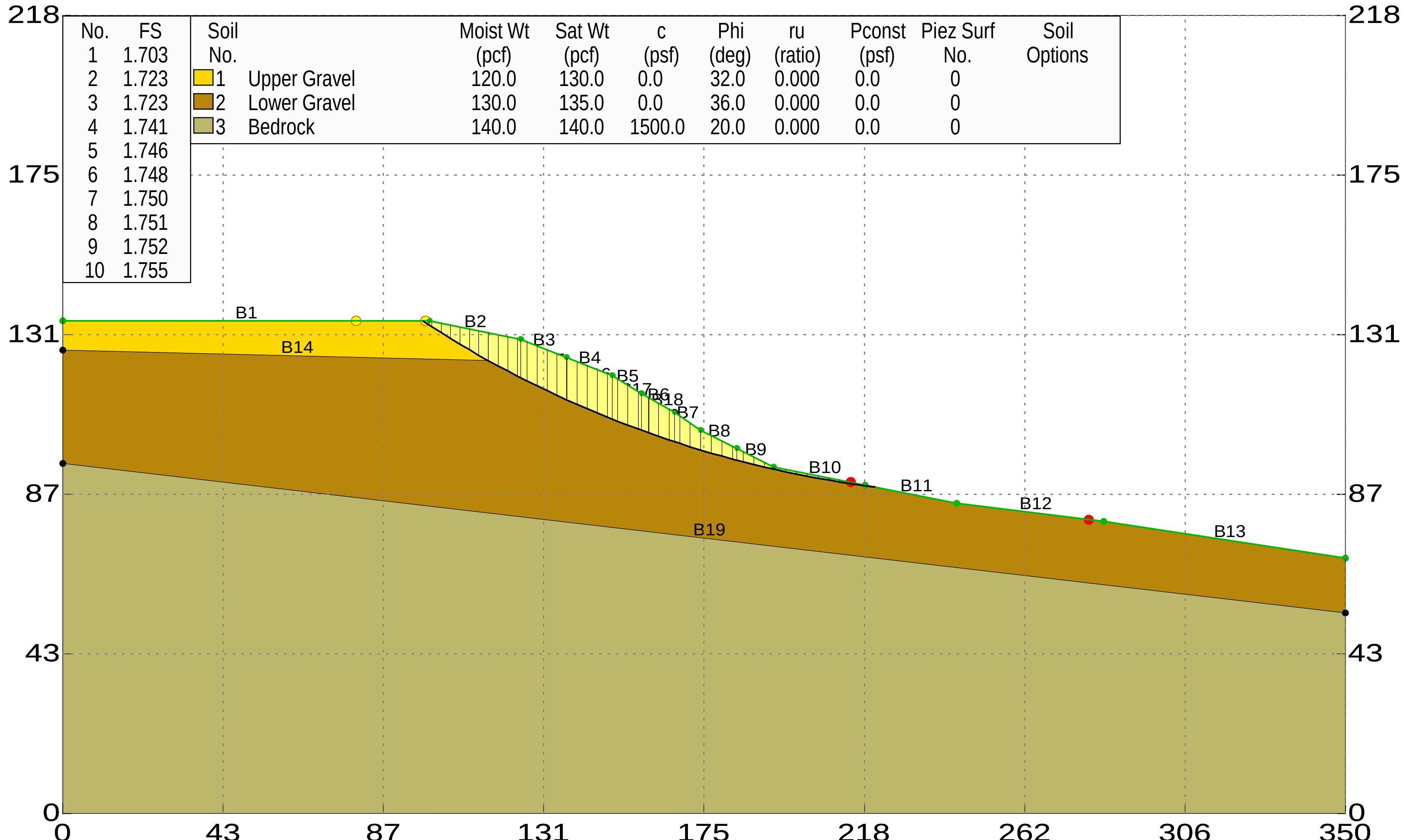
- Well-graded Gravel with silt and sand
- Poorly-graded Gravel with Silt and Sand
- Lean Clay with Gravel
- Claystone
- Sandstone

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is w/ Seismic

Terracon Consultants, Inc. - MDH

\As Is.gsd



No.	FS
1	1.703
2	1.723
3	1.723
4	1.741
5	1.746
6	1.748
7	1.750
8	1.751
9	1.752
10	1.755

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	0	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	0	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	0	

GEOSTASE FS =1.703

Simplified Janbu Method

GEOSTASE Slope Stability Analysis

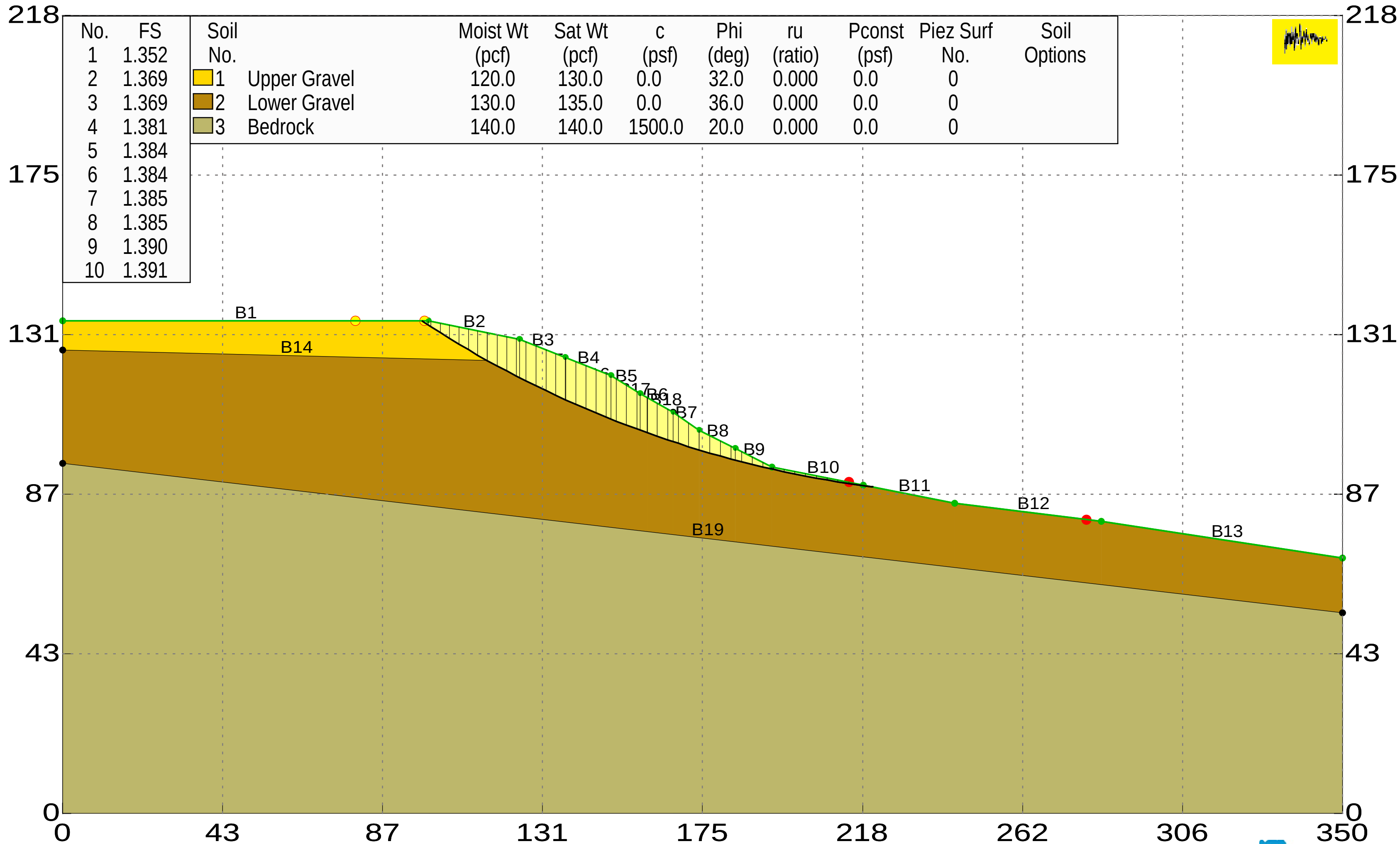
Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is w/ Seismic

Terracon Consultants, Inc. - MDH

\As Is seismic.gsd



GEOSTASE FS =1.352

Simplified Janbu Method

kh = 0.09000

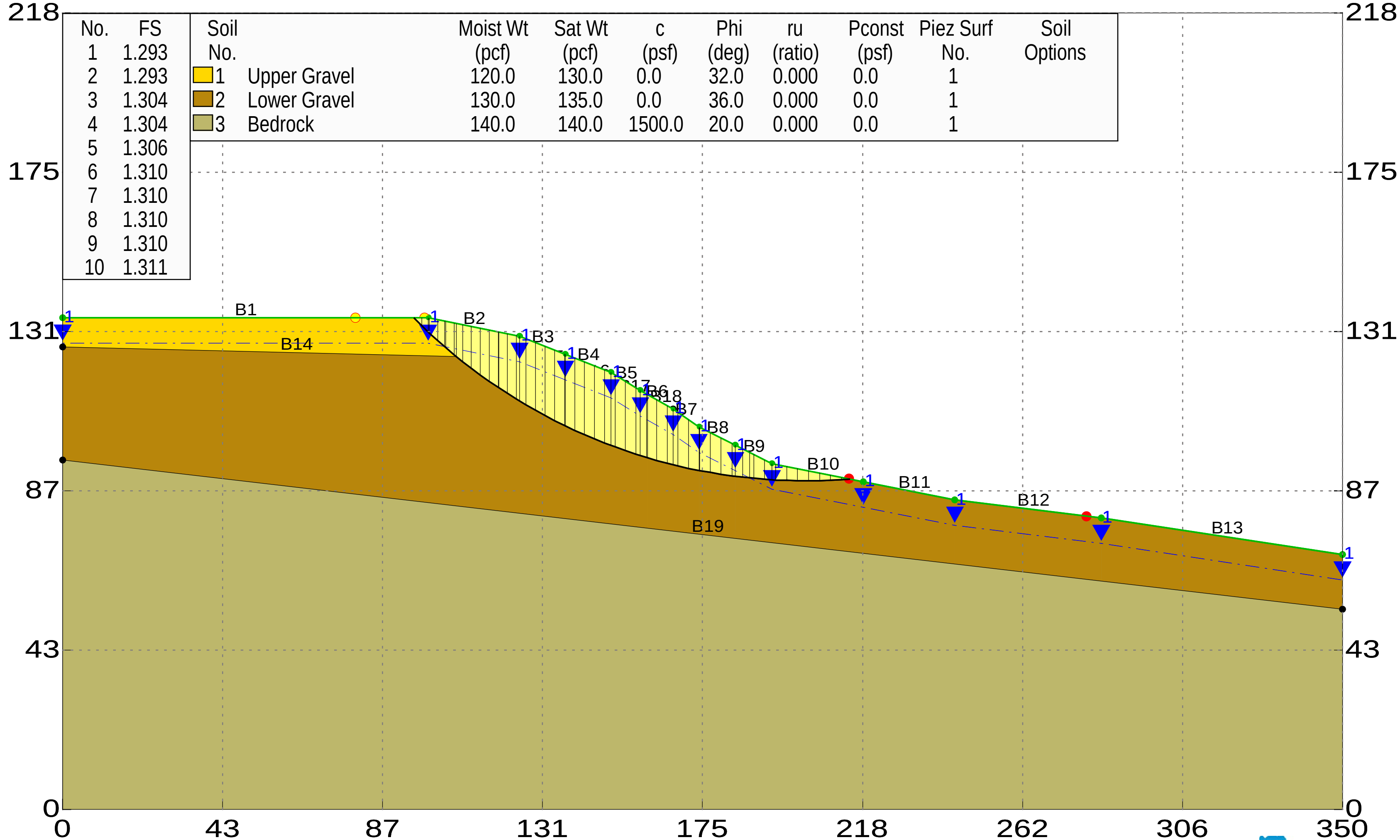
GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

GEOSTASE Slope Stability Analysis

Terracon

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is w/ Water

Terracon Consultants, Inc. - MDH \As Is.gsd



No.	FS
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2	1.293
3	1.304
4	1.304
5	1.306
6	1.310
7	1.310
8	1.310
9	1.310
10	1.311

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	1	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	1	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	1	

GEOSTASE FS =1.293

Simplified Janbu Method

GEOSTASE Slope Stability Analysis

Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

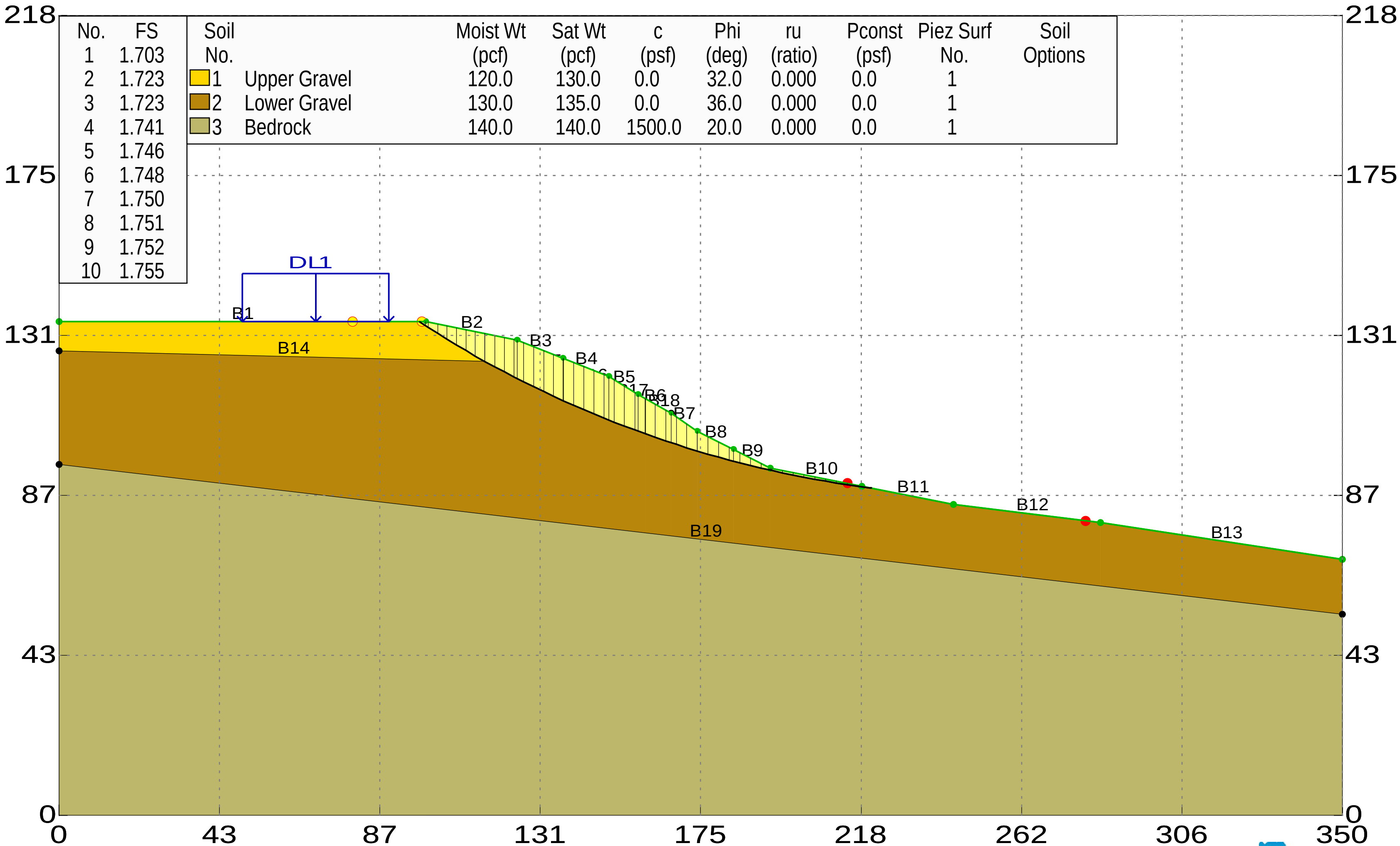
Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is w/ Structure

Terracon Consultants, Inc. - MDH

\As Is.gsd

No.	FS
1	1.703
2	1.723
3	1.723
4	1.741
5	1.746
6	1.748
7	1.750
8	1.751
9	1.752
10	1.755

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	1	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	1	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	1	



GEOSTASE FS =1.703

Simplified Janbu Method

GEOSTASE Slope Stability Analysis

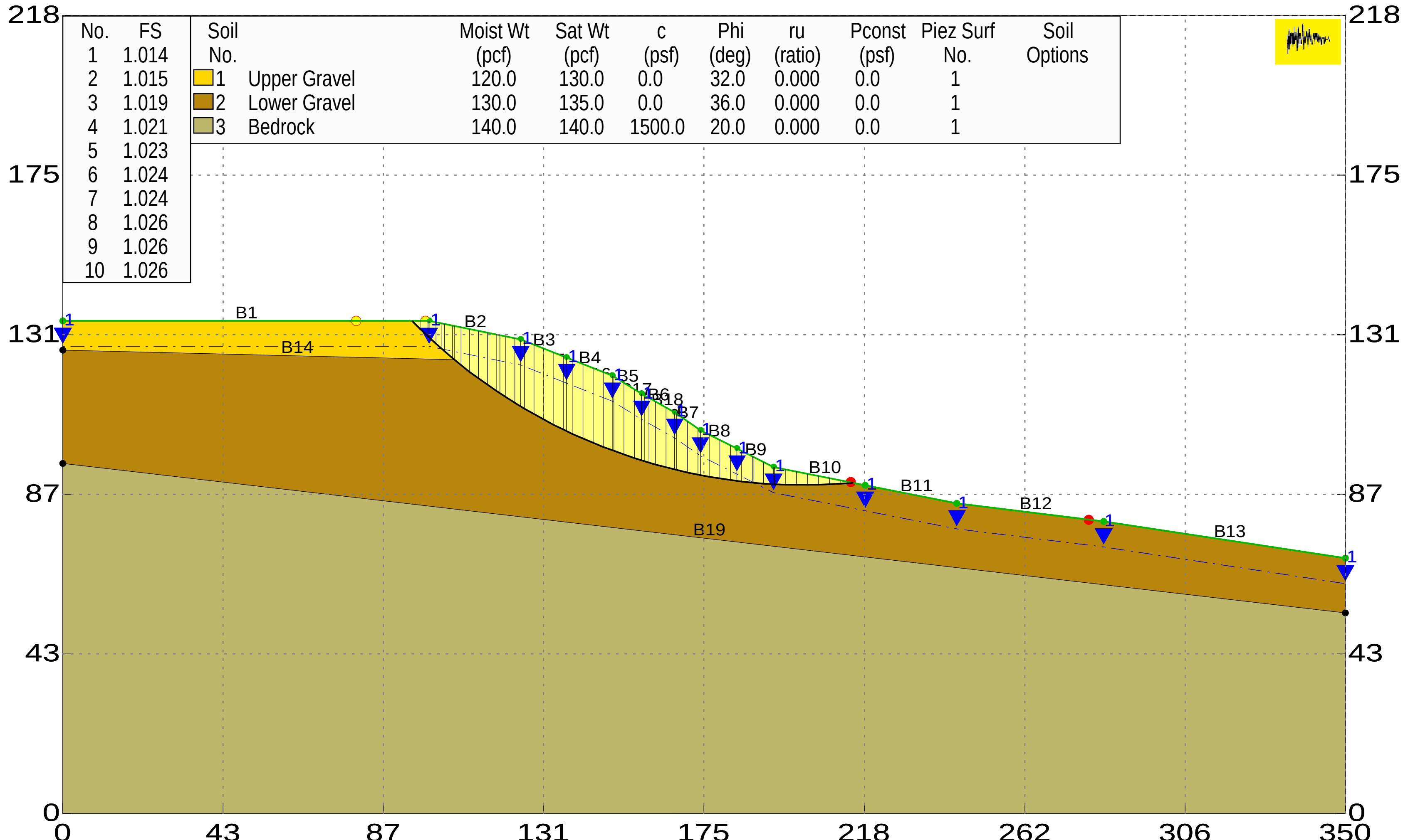
Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is w/ Seismic + Water

Terracon Consultants, Inc. - MDH

\As Is seismic.gsd



GEOSTASE FS =1.014

Simplified Janbu Method

kh = 0.09000

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

GEOSTASE Slope Stability Analysis

Terracon

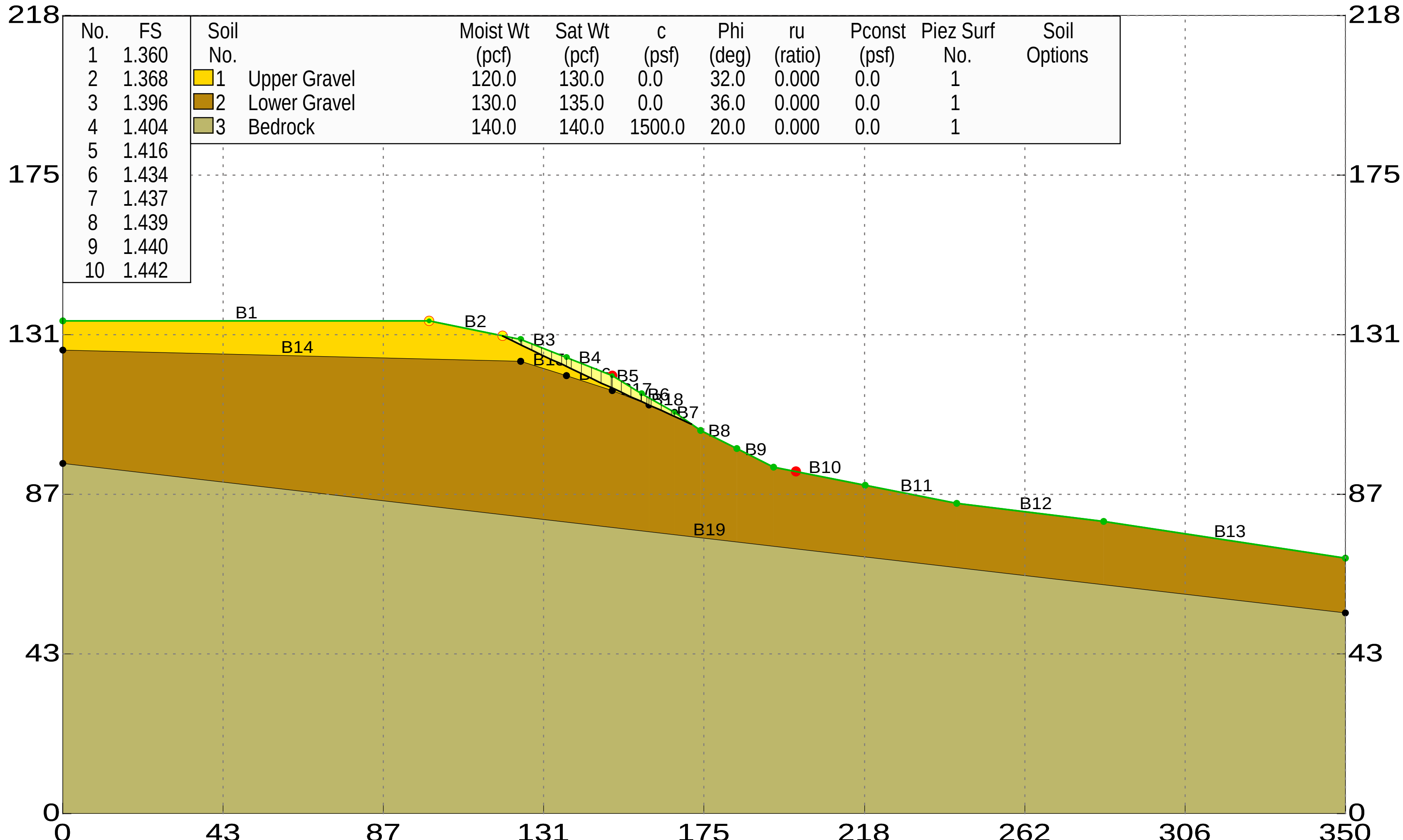
Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is (Localized)

Terracon Consultants, Inc. - MDH

\As Is.gsd

No.	FS
1	1.360
2	1.368
3	1.396
4	1.404
5	1.416
6	1.434
7	1.437
8	1.439
9	1.440
10	1.442

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	1	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	1	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	1	



GEOSTASE FS =1.360

Simplified Janbu Method

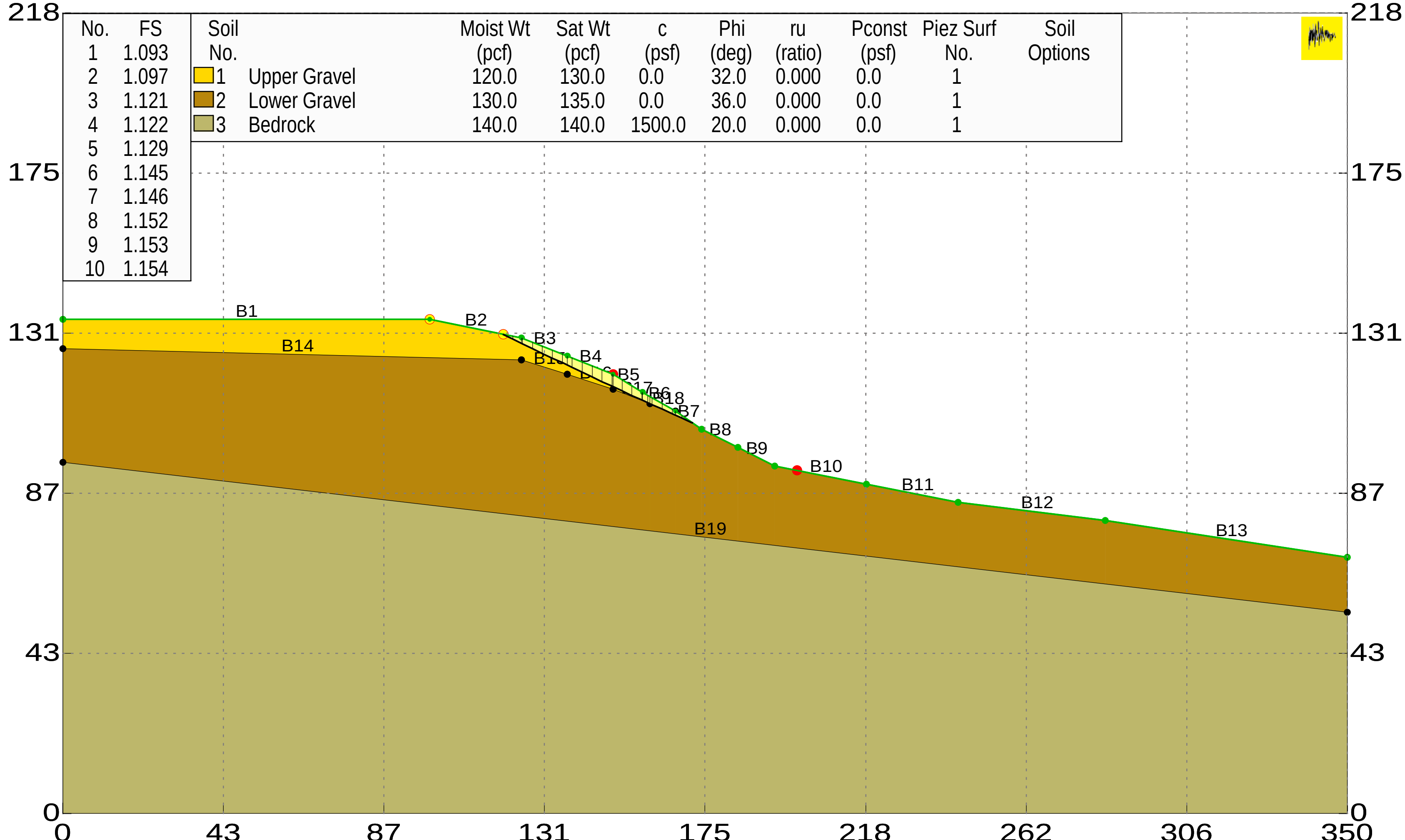
GEOSTASE
Slope Stability
Analysis

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is (Localized w/ Seismic)

Terracon Consultants, Inc. - MDH

\Localized.gsd



GEOSTASE FS =1.093

Simplified Janbu Method

kh = 0.09000

GEOSTASE Slope Stability Analysis

Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

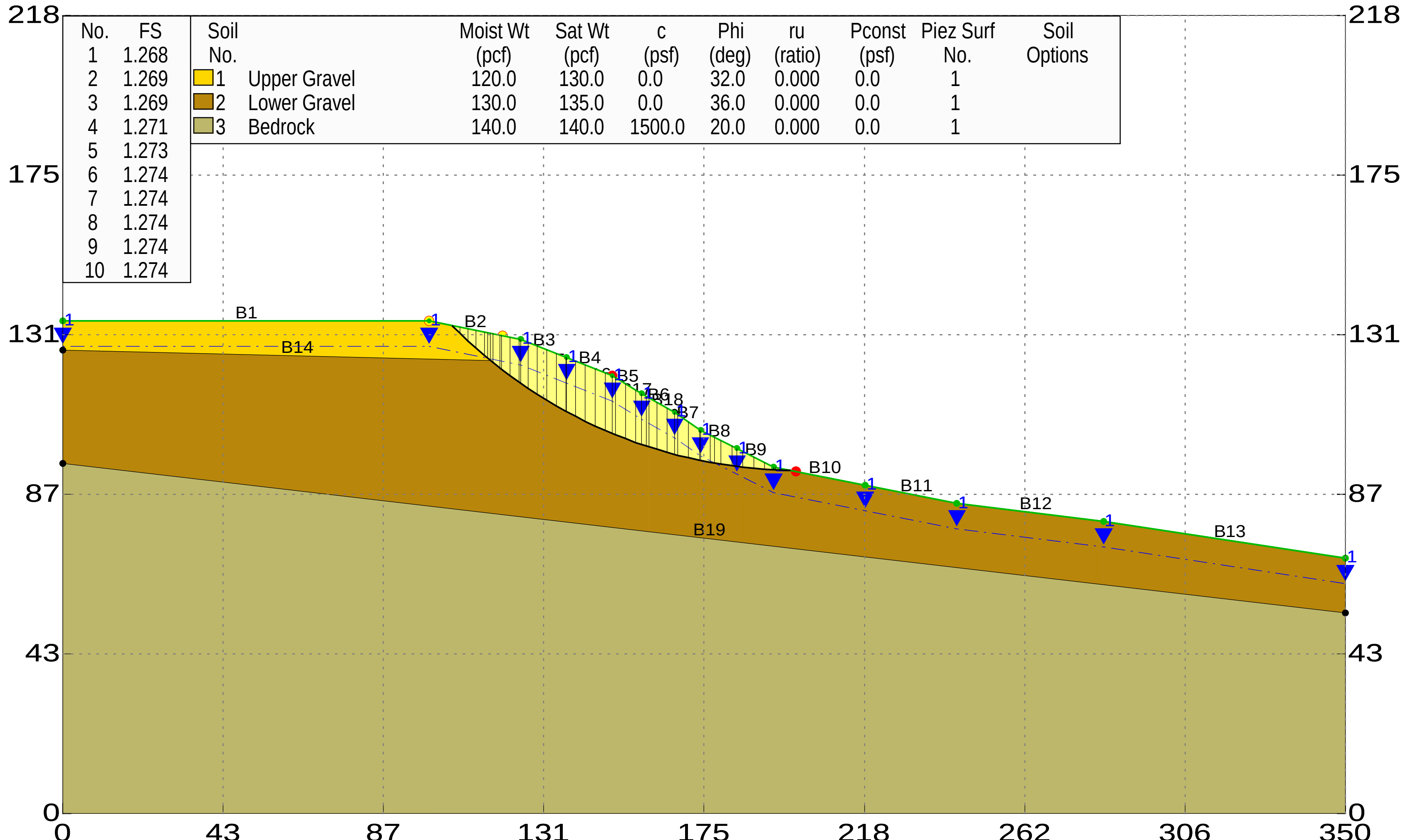
Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is (Localized w/ Water)

Terracon Consultants, Inc. - MDH

\Localized.gsd

No.	FS
1	1.268
2	1.269
3	1.269
4	1.271
5	1.273
6	1.274
7	1.274
8	1.274
9	1.274
10	1.274

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	1	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	1	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	1	



GEOSTASE FS =1.268

Simplified Janbu Method

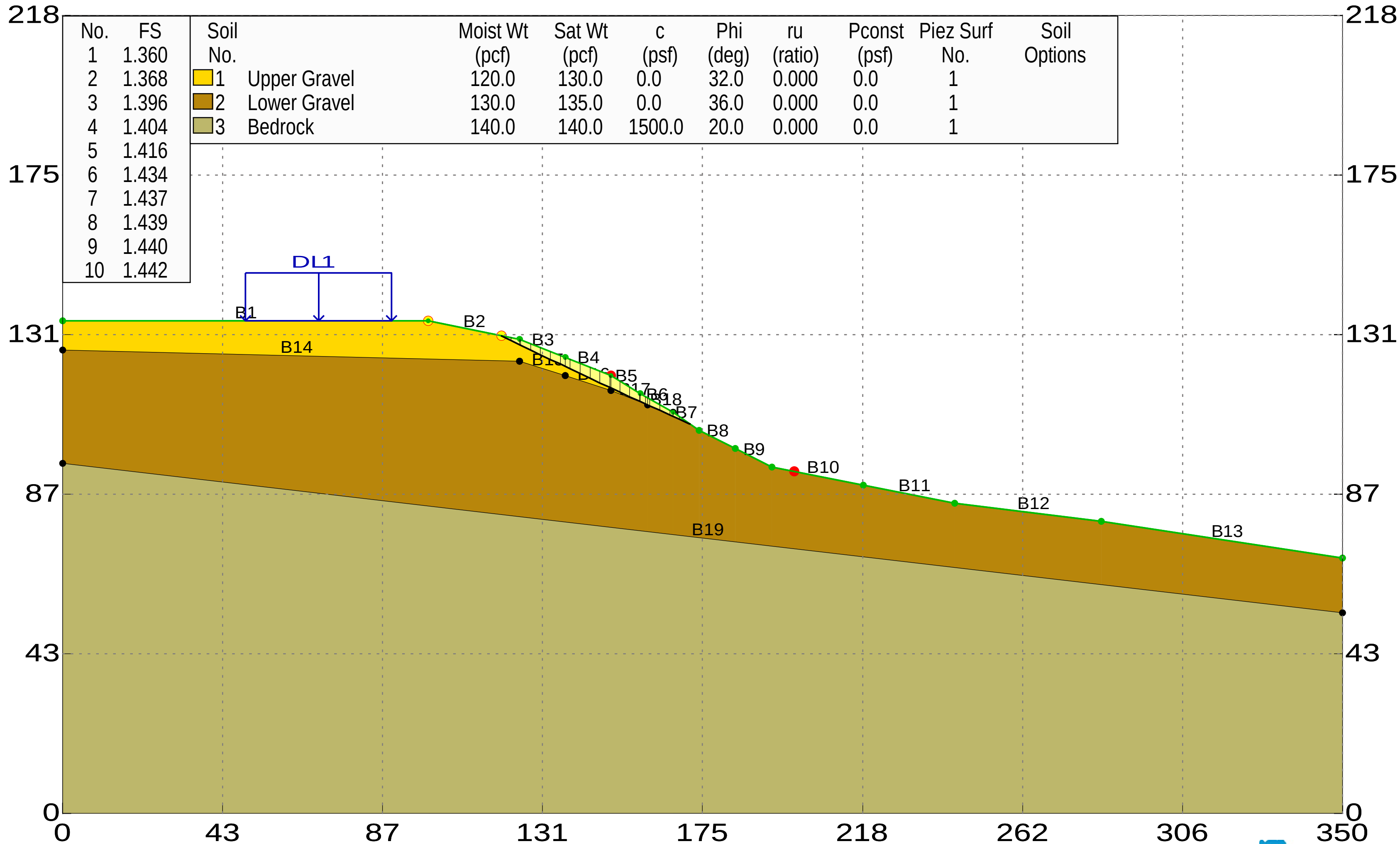
GEOSTASE Slope Stability Analysis

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is (Localized w/ Structure)

Terracon Consultants, Inc. - MDH

\Localized.gsd



GEOSTASE FS =1.360

Simplified Janbu Method

GEOSTASE Slope Stability Analysis

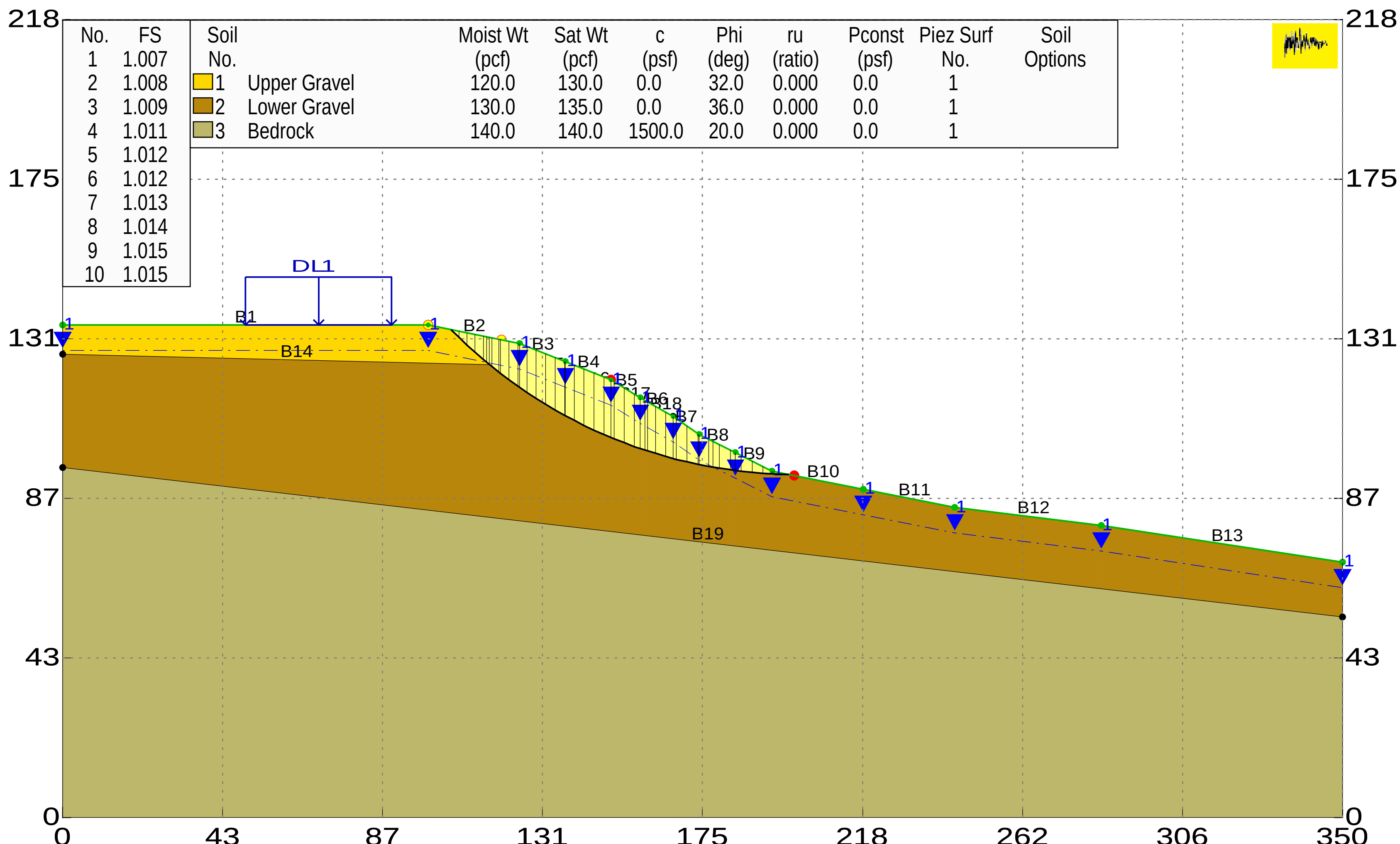
Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

Temple at Nielson Site - Cody, WY
Section A-A' Stability As-Is (Localized w/ Seismic + Water)

Terracon Consultants, Inc. - MDH

\Localized.gsd



No.	FS
1	1.007
2	1.008
3	1.009
4	1.011
5	1.012
6	1.012
7	1.013
8	1.014
9	1.015
10	1.015

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
1	Upper Gravel	120.0	130.0	0.0	32.0	0.000	0.0	1	
2	Lower Gravel	130.0	135.0	0.0	36.0	0.000	0.0	1	
3	Bedrock	140.0	140.0	1500.0	20.0	0.000	0.0	1	

GEOSTASE FS =1.007

Simplified Janbu Method

kh = 0.09000

GEOSTASE Slope Stability Analysis

Terracon

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
6	10.3 to 20.8	Building Area
5	3.9 to 6.5	Pavement Areas
1	70	North Slope Area

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and elevations were obtained by DJ&A during field survey operations and provided to Terracon.

Subsurface Exploration Procedures: Our exploration was completed between June 14 and June 17, 2022, when we advanced the borings with a subcontracted, track-mounted CME 45 drill rig owned and operated by Boland Drilling. The borings were advanced using a combination of hollow stem continuous flight augers or ODEX, casing advanced overburden drilling techniques in the overburden. For the deep boring at the north slope area (DH-1), NQ/HQ wireline rock core drilling was utilized to obtain 25 feet of continuous bedrock core. In general, four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Bulk samples were obtained from auger cutting in the pavement boring locations for use in determination of subgrade modulus characteristics. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Other Testing: In addition to the borings outlined in the table above, we performed percolation tests in general accordance with the City of Cody Public Works requirements at two locations on the site. The results of the percolation tests are summarized and provided with the exploration results below.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
- ASTM D1883 Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
- AASHTO T288 Standard Method of Test for Determining Minimum Laboratory Soil Resistivity

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

Other Testing: Soil analytical testing for water soluble sulfate and pH were performed by Energy Laboratories in Helena, MT. Results are attached.

PHOTOGRAPHY LOG

View of drilling at DH-1 looking west

View looking west-southwest at site from near DH-1

View of looking south from near northeast corner of site

View looking northeast from site near northeast corner of site

View of north slope, from base of slope looking south to drill at DH-1

View of north slope, from base of slope looking southeast to drill at DH-1

View of past failure wedge on north slope, looking east to drill on DH-1

View looking south from northwest corner of site, along west property line

Core from DH-1, 45.0 to 50.0 feet

Core from DH-1, 50.0 to 55.0 feet

Core from DH-1, 55.0 to 60.0 feet

Core from DH-1, 65.0 to 70.0 feet, photo missing from 60.0 to 65.0 feet

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Temple at the Nielson Site ■ Cody, Wyoming

August 18, 2022 ■ Terracon Project No. 26225020

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Temple at the Nielson Site ■ Cody, Wyoming
August 18, 2022 ■ Terracon Project No. 26225020

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5120° Longitude: -109.0819°

Approximate Surface Elev.: 5141 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, light brown, dry, medium dense, homogeneous	
	7.0		5134+/-
2		**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, light brown, dry, dense to very dense, homogeneous, cobbles	
	20.8		5120.3+/-

Boring Terminated at 20.8 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		X	10	8-10-4 N=14		3.3		NP
5		X	5	5-5-5 N=10		2.6		
		X	6	10-25-20 N=45		2.6		
10		X	8	16-34-28 N=62		2.1		
15		X	4	30-50/2"		1.0		
20		X	4	23-50/3"		2.8		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. B-2

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5120° Longitude: -109.0815°

Approximate Surface Elev.: 5141 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, gray, dry, medium dense, homogeneous				X	3	6-7-7 N=14		3.4		
				5		X	7	6-5-4 N=9		2.2		
	6.0		5135+/-									
2		**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, brownish gray, dry, dense to very dense, homogeneous, cobbles				X	10	31-38-50/4"		0.0		
	10.3		5130.7+/-	10		X	4	50/4"		0.0		

Boring Terminated at 10.3 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. B-3

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5118° Longitude: -109.0819°

Approximate Surface Elev.: 5140 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
2		**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, brown, dry, dense to very dense, homogeneous, cobbles									
					X	6	9-8-18 N=26		2.6		NP
			5		X	3	20-50/4"		1.3		
					X	12	26-32-30 N=62		3.3		
			10		X	6	26-50/3"		2.2		
		15.2 / 5124.8+/-	15		X	0	50/2"				
		Boring Terminated at 15.2 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. B-4

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5118° Longitude: -109.0814°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
3	1.5	**LEAN CLAY WITH GRAVEL (CL)**, low plasticity, dark brown, moist, stiff, homogeneous	5136.5+/-									
1	4.5	**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, moist, medium dense, homogeneous	5133.5+/-			X	4	10-12-11 N=23		7.5		
2	10.3	**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, gray, dry, dense to very dense, homogeneous, cobbles	5127.7+/-	5		X	5	18-12-21 N=33		0.0		
						X	6	29-50/4"		2.4		
				10		X	4	50/4"		0.0		

Boring Terminated at 10.3 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. B-5

PROJECT: Nielson Site

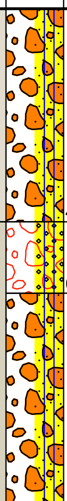
CLIENT: DJ&A PC Missoula, MT

SITE: North of Skyline Dr and Cody Canal Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5116° Longitude: -109.0817°

Approximate Surface Elev.: 5140 (Ft.) +/-



MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1	4.5	**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, tan, dry, medium dense, homogeneous	5135.5+/-			X	5	6-7-5 N=12		2.9		
2	6.0	**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, dark brown, dry, dense, homogeneous	5134+/-	5		X	12	6-8-30 N=38		5.3		
		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), coarse grained, subrounded, tan, dry, dense to very dense, homogeneous, cobbles				X	6	40-50/4"		2.3		
	10.5		5129.5+/-	10		X	2	50/6"		0.5		

Boring Terminated at 10.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. B-6

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5116° Longitude: -109.0814°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
2		**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, gray, dry, medium dense to very dense, homogeneous, cobbles									
					X	6	4-5-6 N=11		2.3		
			5		X	8	6-8-10 N=18		3.5		
					X	5	15-50/5"		2.7		
			10		X	3	50/5"		0.0		
		15.3 / 5122.8+/-	15		X	2	50/3"		0.0		
		Boring Terminated at 15.3 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. P-1

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5121° Longitude: -109.0814°

Approximate Surface Elev.: 5136 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
3		**LEAN CLAY WITH GRAVEL (CL)**, low plasticity, dark brown, moist, stiff, homogeneous 1.5 — 5134.5+/-									
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, dry, medium dense to dense, homogeneous				6	5-5-7 N=12		4.7		39-20-19
			5			12	11-17-20 N=37		1.8		
		6.5 — 5129.5+/-									
		Boring Terminated at 6.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-16-2022	Boring Completed: 06-16-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. P-2

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5119° Longitude: -109.0822°

Approximate Surface Elev.: 5141 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, moist, medium dense, homogeneous									
						12	10-12-12 N=24		5.4		
		5.5 — 5135.5+/-	5			10	10-12-8 N=20		4.6		
		Auger Refusal at 5.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-17-2022	Boring Completed: 06-17-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. P-3

PROJECT: Nielson Site

CLIENT: DJ&A PC Missoula, MT

SITE: North of Skyline Dr and Cody Canal Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5116° Longitude: -109.0825°

Approximate Surface Elev.: 5142 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, dry, medium dense, homogeneous										
						X	9	9-8-13 N=21		3.3		
				5		X	11	10-12-11 N=23		2.9		
		6.5	5135.5+/-									
		Boring Terminated at 6.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-17-2022	Boring Completed: 06-17-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. P-4

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5116° Longitude: -109.0811°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
3		**LEAN CLAY WITH GRAVEL (CL)**, low plasticity, dark brown, moist, stiff, homogeneous 2.0	5136+/-									
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, dry, very dense, homogeneous 3.9	5134.1+/-			X	12	20-30-50/5"		4.2		
		Auger Refusal at 3.9 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-17-2022

Boring Completed: 06-17-2022

Drill Rig: Track Rig

Driller: Boland Drilling - B. Hardy

Project No.: 26225020

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. P-5

PROJECT: Nielson Site

CLIENT: DJ&A PC Missoula, MT

SITE: North of Skyline Dr and Cody Canal Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5114° Longitude: -109.0818°

Approximate Surface Elev.: 5142 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, moist, medium dense, homogeneous			X	12	8-6-9 N=15		8.4		
			5		X	12	12-8-7 N=15		4.7		
		6.5 — 5135.5+/-									
		Boring Terminated at 6.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-17-2022	Boring Completed: 06-17-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. DH-1

PROJECT: Nielson Site

CLIENT: DJ&A PC Missoula, MT

SITE: North of Skyline Dr and Cody Canal Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5122° Longitude: -109.0819°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
1		**WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)**, fine grained, subangular, brown, moist to dry, medium dense, homogeneous				X	8	4-5-8 N=13		11.1		
						X	10	4-5-5 N=10		4.6		
				5		X	8	9-4-4 N=8		1.7		
2	8.0	**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, tan, dry, dense to very dense, homogeneous, cobbles	5130+/-			X	10	8-21-25 N=46		1.3		
				10		X	6	18-50/2"		5.8		
				15		X	6	16-18-27 N=45		1.6		
				20		X	7	31-27-50/4"		2.4		
				25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX & CORE

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-14-2022	Boring Completed: 06-15-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

BORING LOG NO. DH-1

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5122° Longitude: -109.0819°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
2		**POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, coarse grained, subrounded, tan, dry, dense to very dense, homogeneous, cobbles *(continued)*					6	40-50/2"		2.0		NP
				30			8	48-50/5"		2.5		
				35			6	24-50/5"		3.0		
	39.0		5099+/-									
4		**CLAYSTONE**, maroon, moist, fine-grained, moderately fractured, close fracture spacing, thin bedding, highly weathered, weak rock, trace of gravel and sand		40			8	25-50/5"		14.5		
				45			40	RQD = 48%				
				50								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX & CORE

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-14-2022 | Boring Completed: 06-15-2022

Drill Rig: Track Rig | Driller: Boland Drilling - B. Hardy

Project No.: 26225020

BORING LOG NO. DH-1

PROJECT: Nielson Site

CLIENT: DJ&A PC
Missoula, MT

SITE: North of Skyline Dr and Cody Canal
Cody, WY

LOCATION See Exploration Plan

Latitude: 44.5122° Longitude: -109.0819°

Approximate Surface Elev.: 5138 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
4		**CLAYSTONE**, maroon, moist, fine-grained, moderately fractured, close fracture spacing, thin bedding, highly weathered, weak rock, trace of gravel and sand *(continued)*				56	RQD = 86%	7270	13.3	75	
			55			48	RQD = 44%				
			60			0	RQD = 0%				
		64.0 — 5074+/-									
		SANDSTONE, light greenish gray, fine-grained, moderately fractured, close fracture spacing, thin bedding, unweathered, weak rock	65								
		67.0 — 5071+/-									
		CLAYSTONE, maroon, moist, fine-grained, moderately fractured, close fracture spacing, thin bedding, highly weathered, weak rock, trace of gravel and sand				17	RQD = 41%				
		70.0 — 5068+/-	70								
		Boring Terminated at 70 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Rope and Cathead
Logged by T. Gilskey

Advancement Method:
ODEX & CORE

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were obtained from Google Earth Pro.

Notes:

WATER LEVEL OBSERVATIONS

None Observed

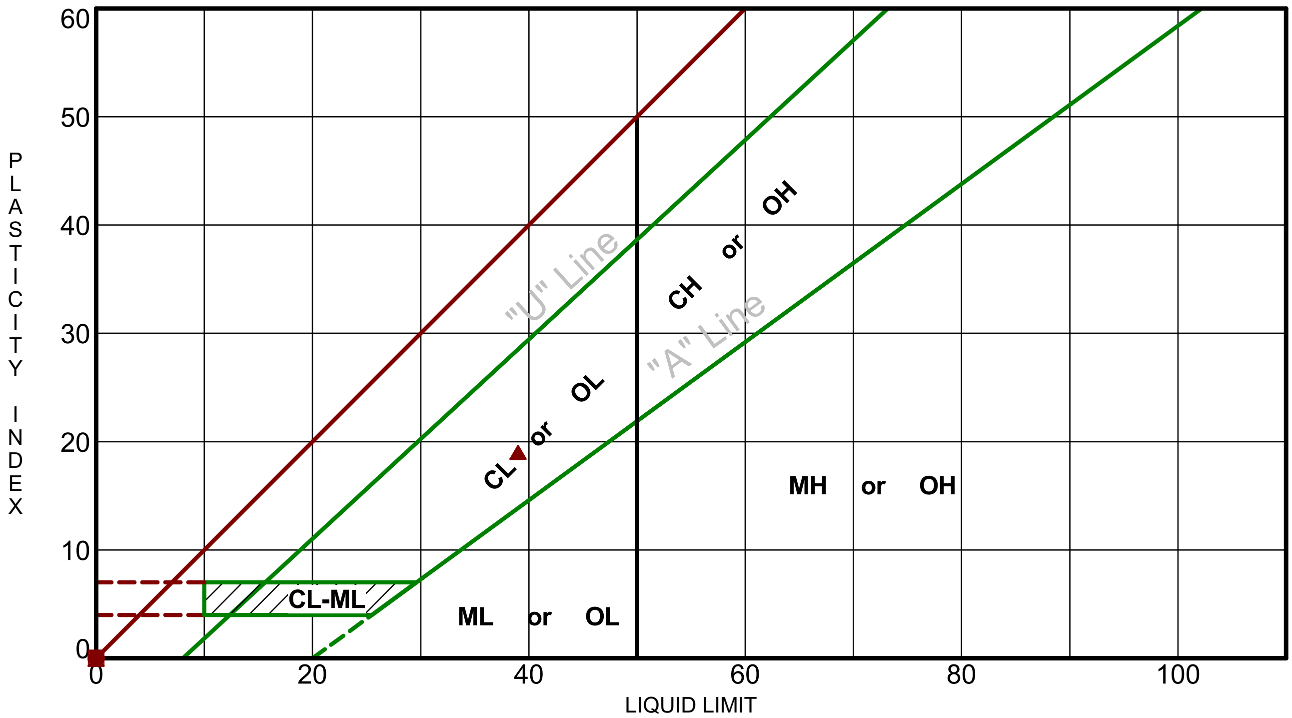
Terracon
2110 Overland Ave Ste 124
Billings, MT

Boring Started: 06-14-2022	Boring Completed: 06-15-2022
Drill Rig: Track Rig	Driller: Boland Drilling - B. Hardy
Project No.: 26225020	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/17/22

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	2.5 - 4	NP	NP	NP	7.1	GW-GM	WELL-GRADED GRAVEL with SILT and SAND
⊠	B-3	2.5 - 4	NP	NP	NP	7.1	GP-GM	POORLY GRADED GRAVEL with SILT and SAND
▲	P-1	0 - 5	39	20	19	26.9	SC	CLAYEY SAND with GRAVEL
★	DH-1	25 - 25.7	NP	NP	NP	6.8	GP-GM	POORLY GRADED GRAVEL with SILT and SAND

PROJECT: Nielson Site

SITE: North of Skyline Dr and Cody Canal
Cody, WY

Terracon
2110 Overland Ave Ste 124
Billings, MT

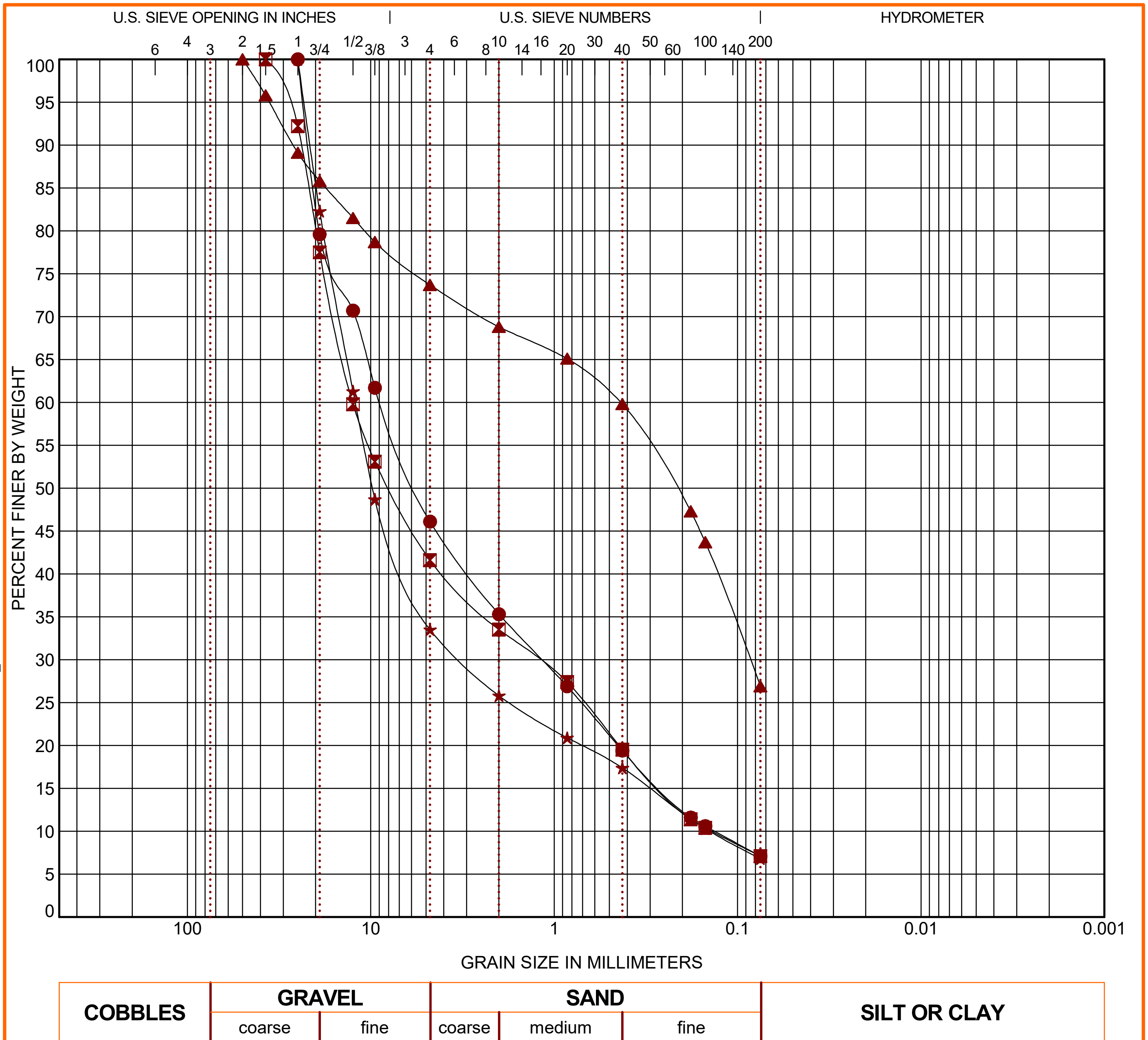
PROJECT NUMBER: 26225020

CLIENT: DJ&A PC
Missoula, MT

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 7/29/22

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-1	2.5 - 4	WELL-GRADED GRAVEL with SILT and SAND (GW-GM)	3.3	NP	NP	NP	1.16	66.14
⊠	B-3	2.5 - 4	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	2.6	NP	NP	NP	0.87	91.07
▲	P-1	0 - 5	CLAYEY SAND with GRAVEL (SC)		39	20	19		
★	DH-1	25 - 25.7	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	2.0	NP	NP	NP	5.98	85.97

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-1	2.5 - 4	25	8.809	1.166	0.133	0.0	53.9	39.0		7.1	
⊠	B-3	2.5 - 4	37.5	12.559	1.224	0.138	0.0	58.4	34.5		7.1	
▲	P-1	0 - 5	50	0.436	0.085		0.0	26.3	46.8		26.9	
★	DH-1	25 - 25.7	25	12.151	3.206	0.141	0.0	66.5	26.7		6.8	

PROJECT: Nielson Site

SITE: North of Skyline Dr and Cody Canal
Cody, WY

Terracon
2110 Overland Ave Ste 124
Billings, MT

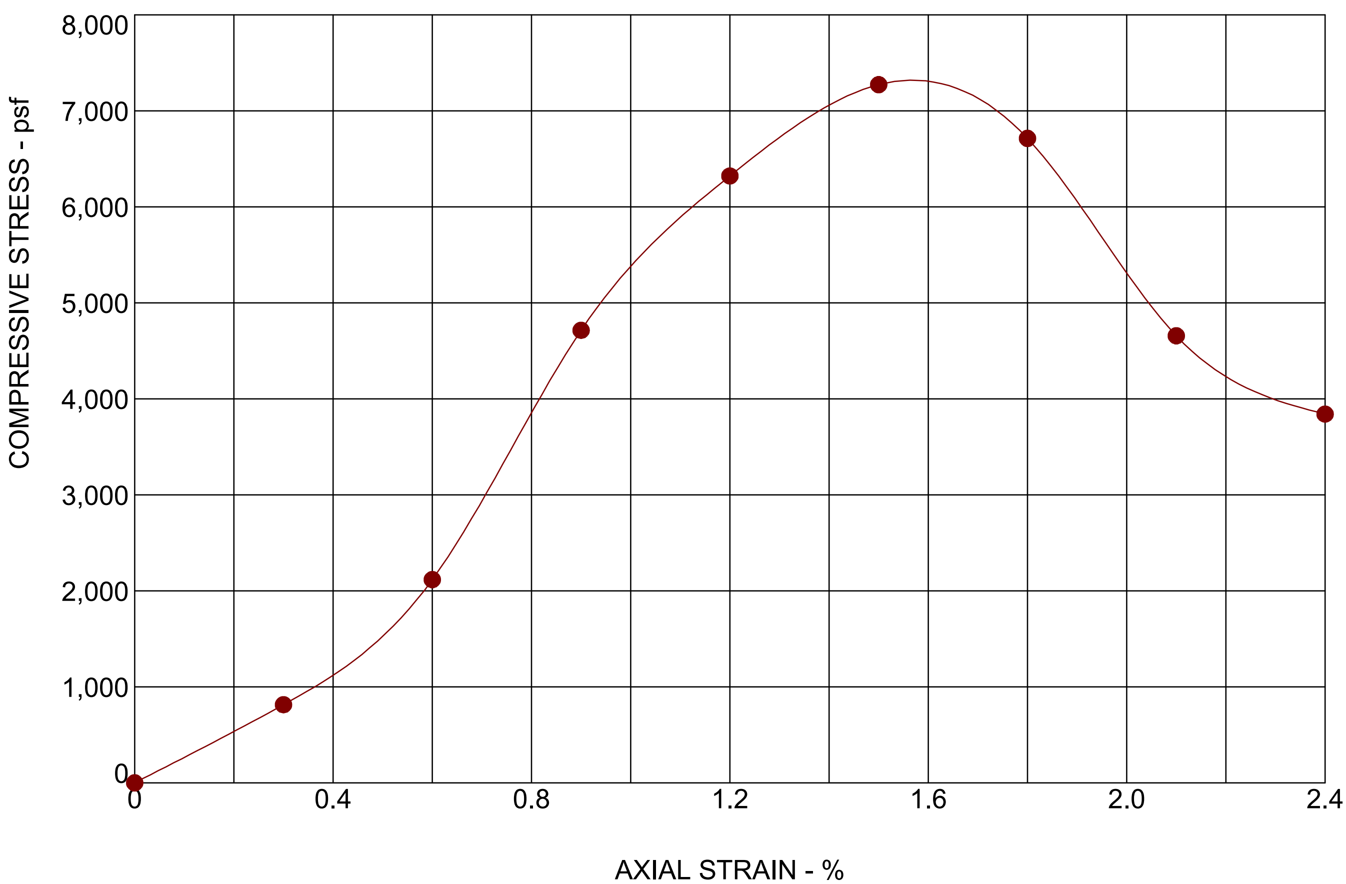
PROJECT NUMBER: 26225020

CLIENT: DJ&A PC
Missoula, MT

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 7/29/22

UNCONFINED COMPRESSION TEST

ASTM D2166



SPECIMEN FAILURE PHOTOGRAPH


SPECIMEN TEST DATA		
Moisture Content:	%	13.3
Dry Density:	pcf	75
Diameter:	in.	1.99
Height:	in.	4.31
Height / Diameter Ratio:		2.17
Calculated Saturation:	%	
Calculated Void Ratio:		
Assumed Specific Gravity:		
Failure Strain:	%	1.50
Unconfined Compressive Strength	(psf)	7273
Undrained Shear Strength:	(psf)	3637
Strain Rate:	in/min	
Remarks:		

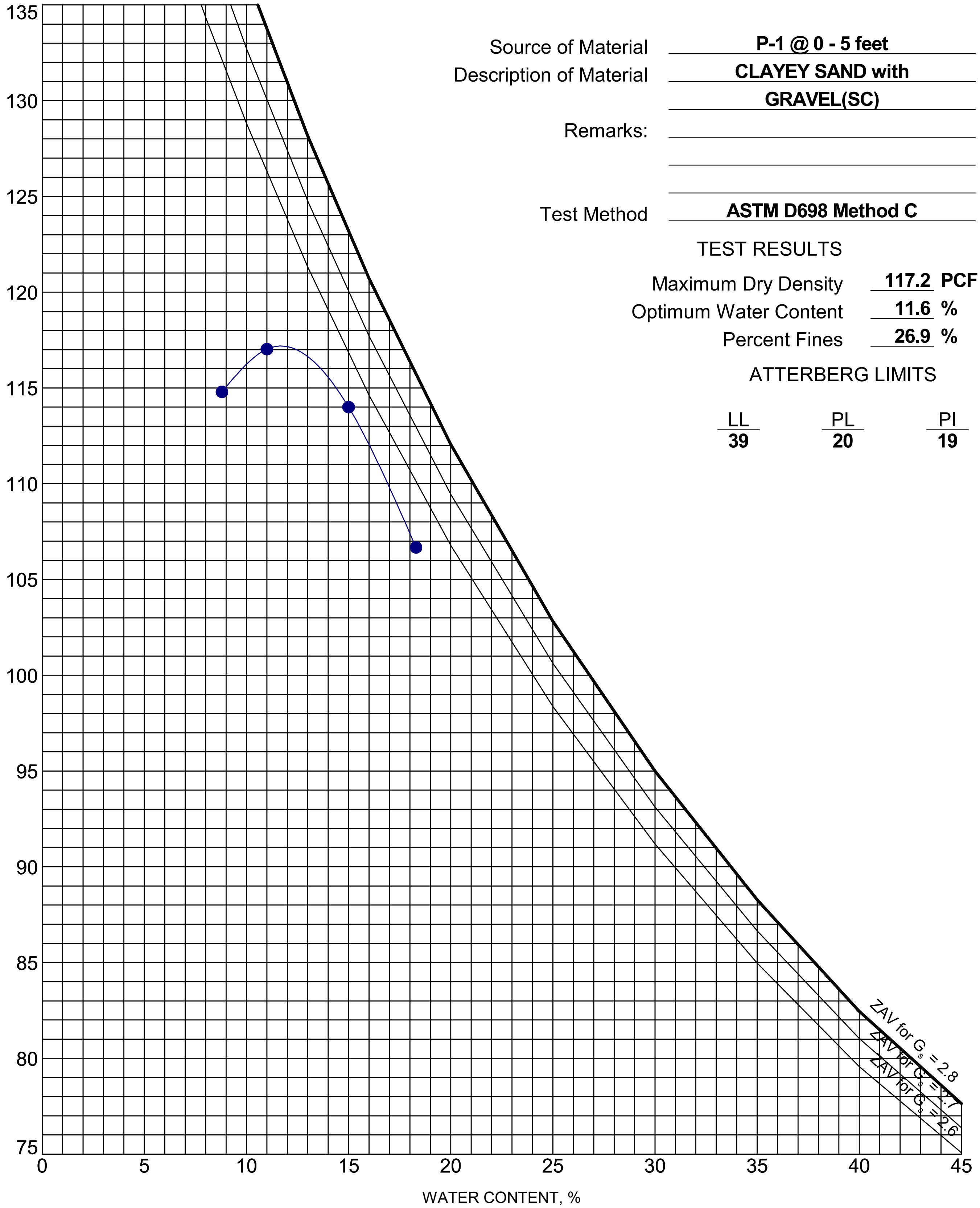
SAMPLE TYPE: CORE	SAMPLE LOCATION: DH-1 @ 53 feet			
DESCRIPTION: CLAYSTONE	LL	PL	PI	Percent < #200 Sieve

PROJECT: Nielson Site	Terracon 2110 Overland Ave Ste 124 Billings, MT	PROJECT NUMBER: 26225020
SITE: North of Skyline Dr and Cody Canal Cody, WY		CLIENT: DJ&A PC Missoula, MT

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. UNCONFINED WITH PHOTOS 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 8/3/22

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**P-1 @ 0 - 5 feet**
Description of Material	**CLAYEY SAND with GRAVEL(SC)**
Remarks:	
Test Method	**ASTM D698 Method C**

TEST RESULTS

Maximum Dry Density	**117.2**	**PCF**
Optimum Water Content	**11.6**	**%**
Percent Fines	**26.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
39	**20**	**19**

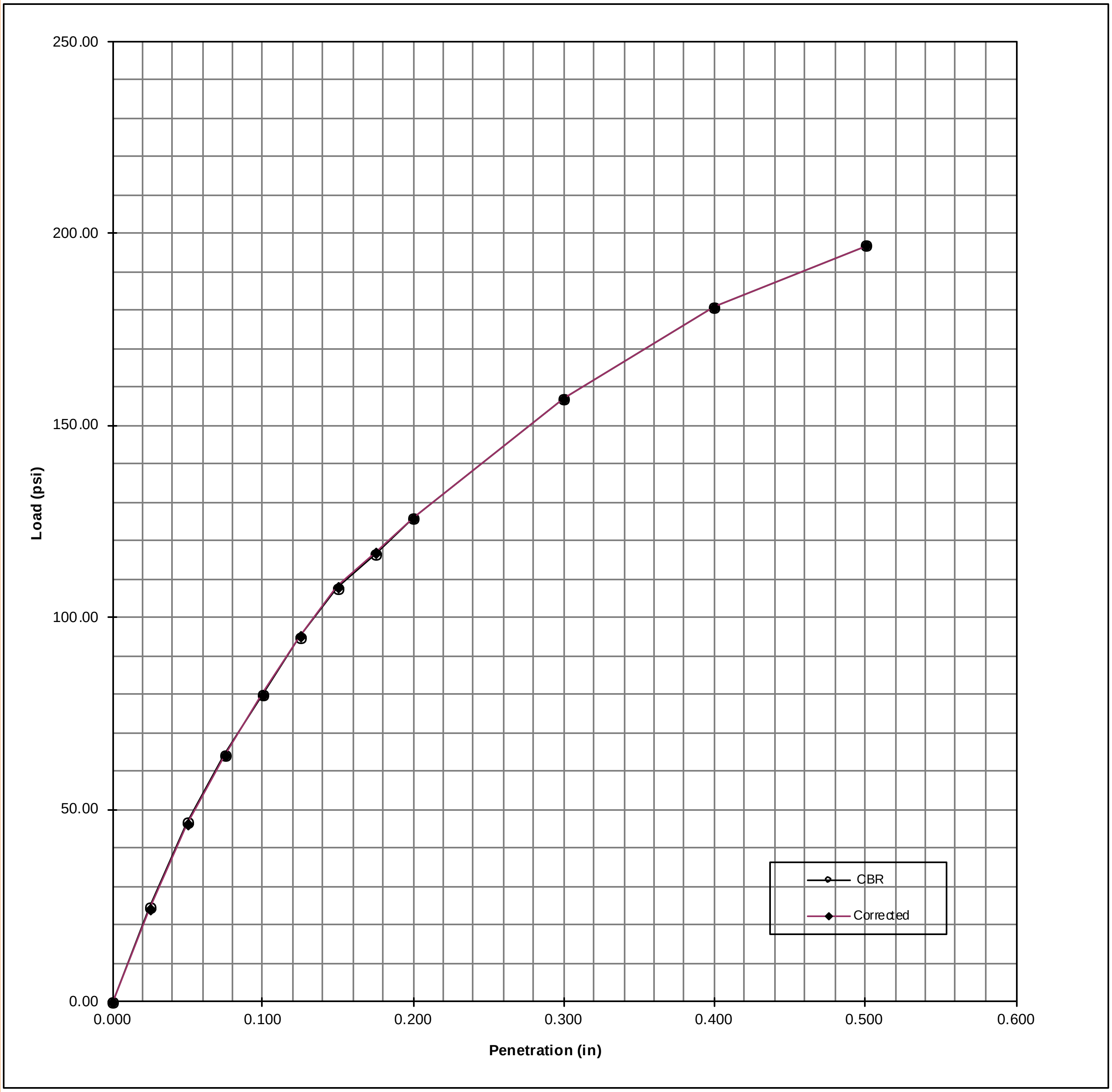
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 26225020 NIELSON SITE.GPJ TERRACON_DATATEMPLATE.GDT 7/29/22

PROJECT: Nielson Site	Terracon 2110 Overland Ave Ste 124 Billings, MT	PROJECT NUMBER: 26225020
SITE: North of Skyline Dr and Cody Canal Cody, WY		CLIENT: DJ&A PC Missoula, MT

CBR Data
ASTM D1883

Boring #:	P-01 to P-05	**Soaked:**	X	**Max Dry Density**	117.2
Depth:	- 0.0-5.0'	**Unsoaked:**		**Opt. Moisture %**	11.6
Soil Type:	Clayey Sand with Gravel (SC)			**Surcharge:**	10#

	Dry Density	MC% Obtained	% of Max Dry Density	CBR value @ .1"	CBR Value @ .2"
	111.3	12.4	95.0	8.00	8.40



PROJECT: Cody Temple	Terracon	PROJECT NUMBER:	26225020
SITE: North of Skyline Dr and Cody	1392 13th Ave S Great Falls, MT	CLIENT:	DJ&A PC

Terracon

Minimum Soil Resistivity

AASHTO T288-92 (1996)

1392 13th Ave SW, Great Falls, Montana 59404 (406) 453-5400

Project: Cody Temple   Date: 8/1/2022

Job No: 26225020   Report No.:   Sample No.: Split Spoon

Drill Hole: B-5   Depth: 5-6.5'   Tested By: TG

Classification: Well Graded Gravel with Silt and Sand (GW-GM)   Reviewed By: MDH

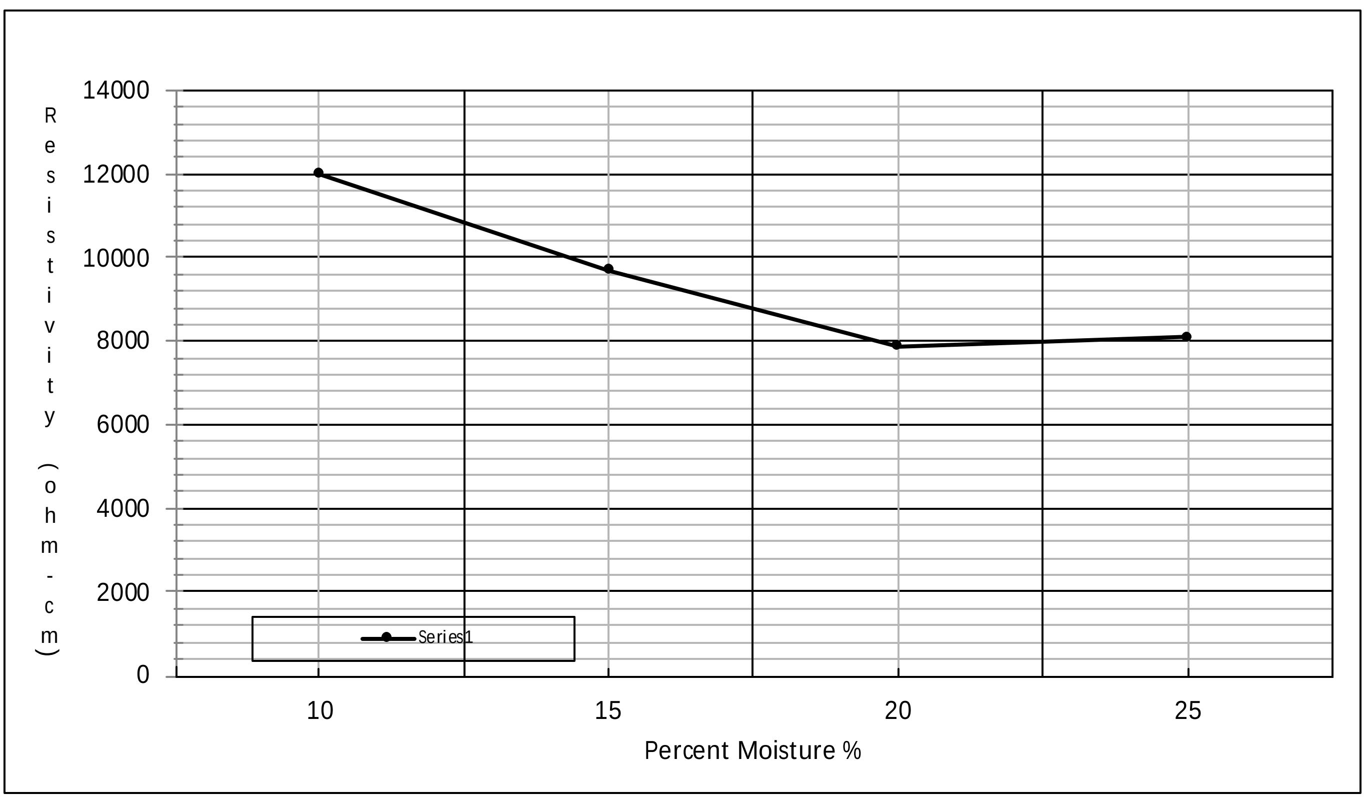
Material Size: -#10

Remarks: pH = 7.8, Sulfate Content = 0.0021% as tested by Energy Laboratories in Helena, MT (see attached)

Soil Data (As Received)

wet (g):	na	Weight of Sample:	200	Initial Moisture %:	10.00
dry (g):	na	As Received MC%:	na	5% Increments	10.00
pan (g):	na	Beginning MC%	10%	Resistivity (ohm-cm):	7,900

% Moisture Added	Reading	Box Constant	Multilplier	Resistivity
10	1.2	10	1000	12000
15	9.7	10	100	9700
20	7.9	10	100	7900
25	8.1	10	100	8100



Minimum Soil Resistivity
AASHTO T288-92 (1996)

1392 13th Ave SW, Great Falls, Montana 59404 (406) 453-5400

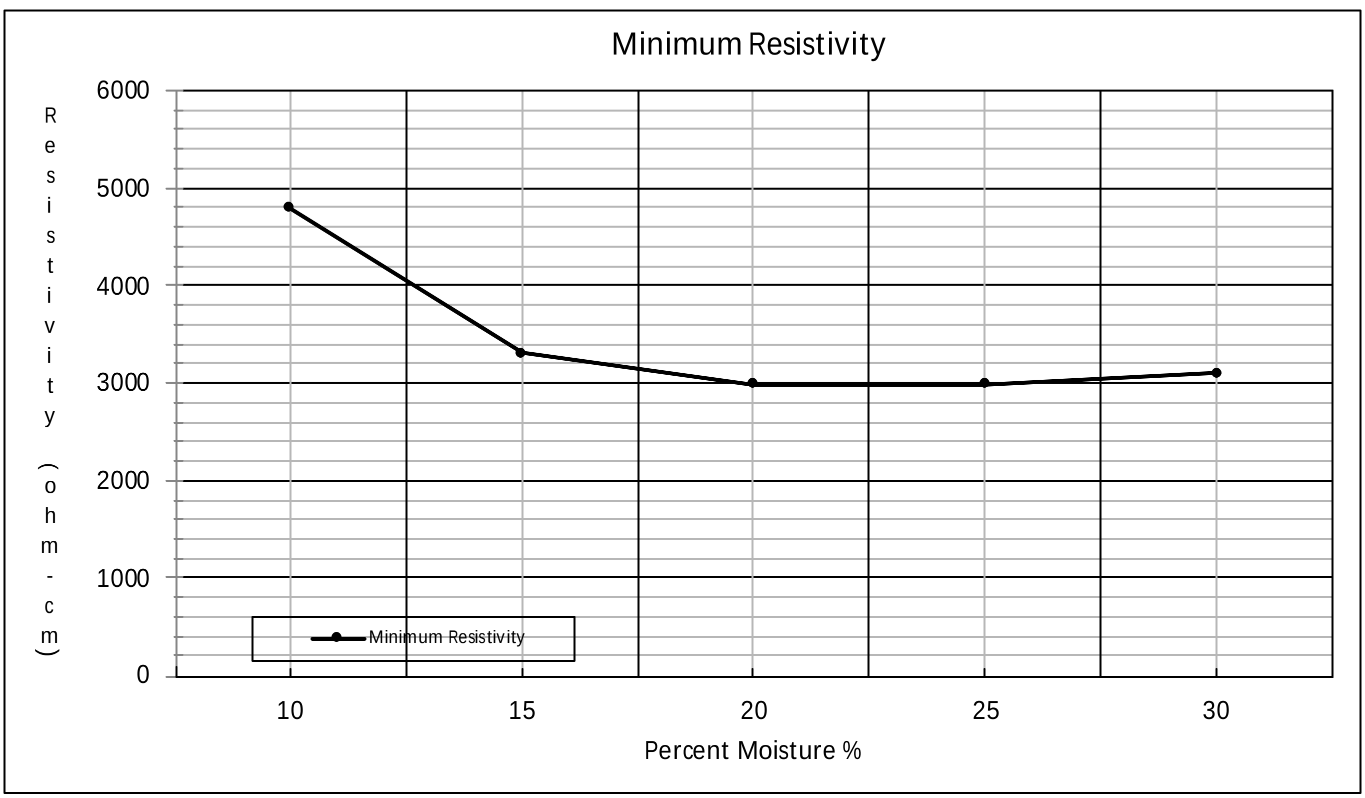
Project: Cody Temple Date: 8/1/2022
Job No: 26225020 Report No.: Sample No.: Split Spoon

Drill Hole: B-6 Depth: 5-9' Tested By: TG
Classification: Poorly Graded Gravel with Silt and Sand (GP-GM) Reviewed By: MDH
Material Size: -#10
Remarks: pH = 8.0, Sulfate Content = 0.0100% as tested by Energy Laboratories in Helena, MT (see attached)

Soil Data (As Received)

wet (g):	na	Weight of Sample:	200	Initial Moisture %:	10.00
dry (g):	na	As Received MC%:	na	5% Increments	10.00
pan (g):	na	Beginning MC%	10%	Resistivity (ohm-cm):	3,000

% Moisture Added	Reading	Box Constant	Multilplier	Resistivity
10	4.8	10	100	4800
15	3.3	10	100	3300
20	3.0	10	100	3000
25	3.0	10	100	3000
30	3.1	10	100	3100



Minimum Soil Resistivity
AASHTO T288-92 (1996)

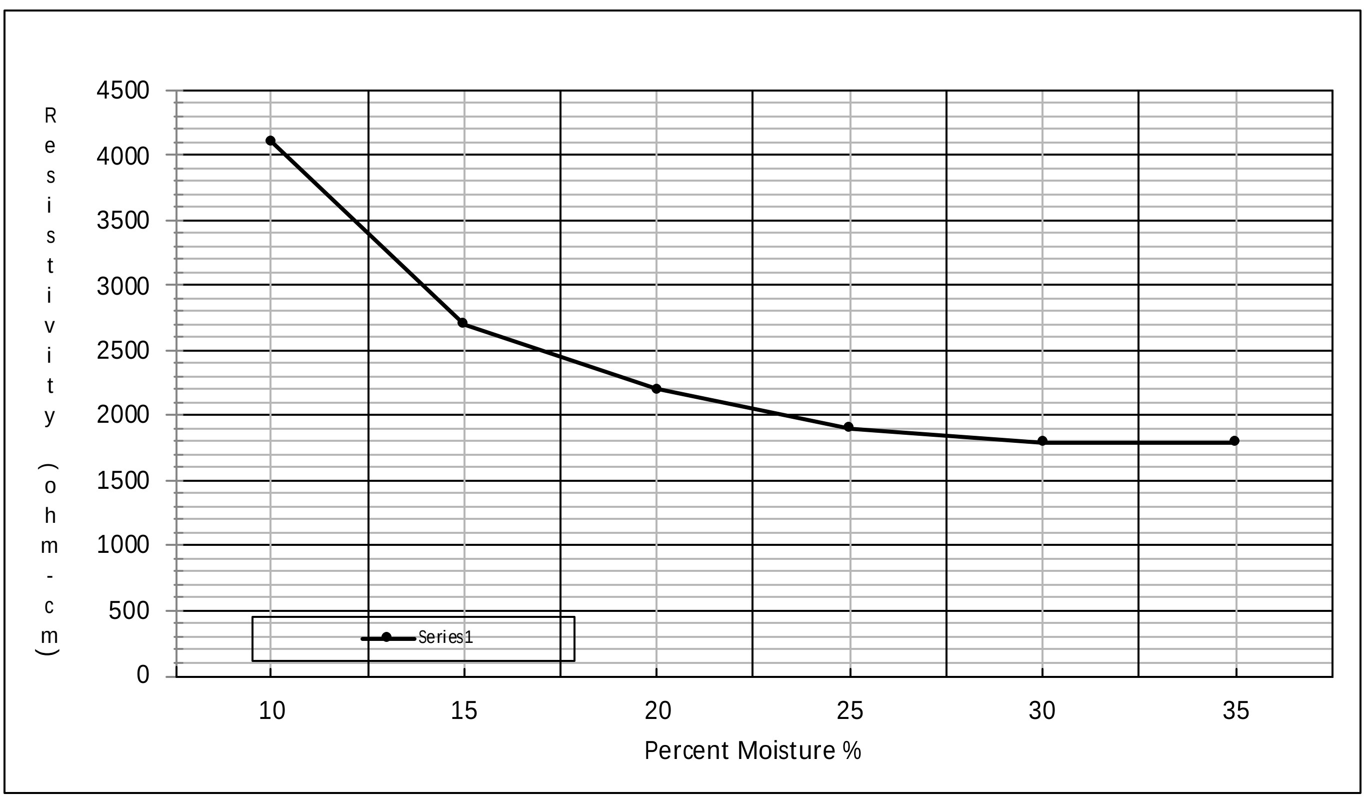
1392 13th Ave SW, Great Falls, Montana 59404 (406) 453-5400

Project:	Cody Temple	Date:	8/1/2022
Job No:	26225020	Sample No.:	Split Spoon
Report No.:			
Drill Hole:	P-1	Tested By:	TG
Depth:	2.5-6.5'	Reviewed By:	MDH
Classification:	Well Graded Gravel with Silt and Sand (GW-GM)		
Material Size:	-#10		
Remarks:	pH = 7.3, Sulfate Content = 0.0607% as tested by Energy Laboratories in Helena, MT (see attached)		

Soil Data (As Received)

wet (g):	na	Weight of Sample:	200	Initial Moisture %:	10.00
dry (g):	na	As Received MC%:	na	5% Increments	10.00
pan (g):	na	Beginning MC%	10%	Resistivity (ohm-cm):	1,800

% Moisture Added	Reading	Box Constant	Multilplier	Resistivity
10	4.1	10	100	4100
15	2.7	10	100	2700
20	2.2	10	100	2200
25	1.9	10	100	1900
30	1.8	10	100	1800
35	1.8	10	100	1800



ANALYTICAL SUMMARY REPORT

August 15, 2022

Terracon Consultants
1392 13th Ave S W
Great Falls, MT 59404-3155

Work Order: H22070674

Project Name: Cody Temple - 26225020

Energy Laboratories Inc Helena MT received the following 3 samples for Terracon Consultants on 7/21/2022 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H22070674-001	Cody Temple; P-01; 2.5-6.5' [2.6-6.5]	06/16/22 13:00	07/21/22	Solid	Anions, Water Extractable pH, 1:X Water Extractable DI Water Soil Extract ASA10-3 Soil Preparation USDA1
H22070674-002	Cody Temple; B-05; 5-6.5' [5-6.5]	06/16/22 13:00	07/21/22	Solid	Anions, Water Extractable pH, 1:X Water Extractable DI Water Soil Extract ASA10-3
H22070674-003	Cody Temple; B-06; 5-9' [5-9]	06/16/22 13:00	07/21/22	Solid	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the report package. Any issues encountered during sample receipt are documented in the Work Order Receipt Checklist.

The results as reported relate only to the item(s) submitted for testing. This report shall be used or copied only in its entirety. Energy Laboratories, Inc. is not responsible for the consequences arising from the use of a partial report.

If you have any questions regarding these test results, please contact your Project Manager.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Terracon Consultants	**Report Date:**	08/15/22
Project:	Cody Temple - 26225020	**Collection Date:**	06/16/22 13:00
Lab ID:	H22070674-001	**DateReceived:**	07/21/22
Client Sample ID:	Cody Temple; P-01; 2.5-6.5' [2.6-6.5]	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
1:X SOIL:WATER							
pH, 1:2	7.3	s.u.		0.1		ASA10-3	08/09/22 15:39 / jjp
WATER EXTRACTABLE							
Sulfate, 1:2	607	mg/kg		1		E300.0	07/25/22 21:07 / SRW

Report Definitions:	RL - Analyte Reporting Limit	MCL - Maximum Contaminant Level
	QCL - Quality Control Limit	ND - Not detected at the Reporting Limit (RL)

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Terracon Consultants	**Report Date:**	08/15/22
Project:	Cody Temple - 26225020	**Collection Date:**	06/16/22 13:00
Lab ID:	H22070674-002	**DateReceived:**	07/21/22
Client Sample ID:	Cody Temple; B-05; 5-6.5' [5-6.5]	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
1:X SOIL:WATER							
pH, 1:2	7.8	s.u.		0.1		ASA10-3	08/09/22 15:40 / jjp
WATER EXTRACTABLE							
Sulfate, 1:2	21	mg/kg		1		E300.0	07/25/22 21:21 / SRW

Report Definitions:
RL - Analyte Reporting Limit
QCL - Quality Control Limit
MCL - Maximum Contaminant Level
ND - Not detected at the Reporting Limit (RL)

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client:	Terracon Consultants	**Report Date:**	08/15/22
Project:	Cody Temple - 26225020	**Collection Date:**	06/16/22 13:00
Lab ID:	H22070674-003	**DateReceived:**	07/21/22
Client Sample ID:	Cody Temple; B-06; 5-9' [5-9]	**Matrix:**	Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
1:X SOIL:WATER							
pH, 1:2	8.0	s.u.		0.1		ASA10-3	08/09/22 15:41 / jjp
WATER EXTRACTABLE							
Sulfate, 1:2	100	mg/kg		1		E300.0	07/25/22 21:36 / SRW

Report Definitions:	RL - Analyte Reporting Limit	MCL - Maximum Contaminant Level
	QCL - Quality Control Limit	ND - Not detected at the Reporting Limit (RL)

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QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Terracon Consultants **Work Order:** H22070674 **Report Date:** 08/15/22

Analyte		Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method:	**ASA10-3**										Batch: 62419
Lab ID:	**LCS-62419**		Laboratory Control Sample				Run: SOIL PH METER - ORION A2				07/25/22 12:54
pH, 1:2			8.25	s.u.	0.10	100	95	105			
Method:	**ASA10-3**						al Run: SOIL PH METER - ORION A211_220815A				
Lab ID:	**ICV_1_220809_1**		Initial Calibration Verification Standard								08/09/22 15:32
pH, 1:2			7.03	s.u.	0.10	100	98.6	101.4			
Lab ID:	**CCV_1_220809_1**		Continuing Calibration Verification Standard								08/09/22 15:33
pH, 1:2			7.01	s.u.	0.10	100	98.6	101.4			
Lab ID:	**CCV1_1_220809_1**		Continuing Calibration Verification Standard								08/09/22 15:35
pH, 1:2			4.01	s.u.	0.10	100	97.5	102.5			
Method:	**ASA10-3**										Batch: 62419
Lab ID:	**H22070674-003ADUP**		Sample Duplicate				Run: SOIL PH METER - ORION A2				08/09/22 15:43
pH, 1:2			7.45	s.u.	0.10				6.6	20	

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: Terracon Consultants **Work Order:** H22070674 **Report Date:** 08/15/22

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0							Analytical Run: IC METROHM_220725A			
Lab ID: ICV		Initial Calibration Verification Standard							07/25/22 17:17	
Sulfate		386	mg/L	1.0	96	90	110			
Lab ID: CCV		Continuing Calibration Verification Standard							07/25/22 18:00	
Sulfate		198	mg/L	1.0	99	90	110			
Method: E300.0									Batch: 62419	
Lab ID: MB-62419		Method Blank				Run: IC METROHM_220725A			07/25/22 20:09	
Sulfate, 1:2		ND	mg/kg	0.08						
Lab ID: LCS-62419		Laboratory Control Sample				Run: IC METROHM_220725A			07/25/22 20:24	
Sulfate, 1:2		621	mg/kg	1.0	94	70	130			
Lab ID: H22070674-003ADUP		Sample Duplicate				Run: IC METROHM_220725A			07/25/22 21:50	
Sulfate, 1:2		94.6	mg/kg	1.0				5.2	20	
Lab ID: H22070674-003AMS		Sample Matrix Spike				Run: IC METROHM_220725A			07/25/22 22:05	
Sulfate, 1:2		2000	mg/kg	1.1	95	90	110			

Qualifiers:

RL - Analyte Reporting Limit

ND - Not detected at the Reporting Limit (RL)

Work Order Receipt Checklist

Terracon Consultants H22070674

Login completed by: Skyler T. Pester Date Received: 7/21/2022
Reviewed by: spester Received by: RMF
Reviewed Date: 8/15/2022 Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all sample bottles?	Yes ☑	No ☐	Not Present ☐
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	23.3°C No Ice		
Containers requiring zero headspace have no headspace or bubble that is <6mm (1/4").	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

The reference date for Radon analysis is the sample collection date. The reference date for all other Radiochemical analyses is the analysis date. Radiochemical precision results represent a 2-sigma Total Measurement Uncertainty.

Contact and Corrective Action Comments:

No collection times listes, collection times estimated in laboratory. 7/21/2022 STP.

Chain Of Custody and Analytical Request Record

PLEASE PRINT, provide as much information as possible. Refer to corresponding notes on reverse side.

Page ____ of ____

Company Name: Terracon	Project Name, PWS #, Permit #, Etc: Cody Temple - 26225020
Report Mail Address: 1392 13th Ave SW, Great Falls, MT 59404	Contact Name, Phone, Fax, E-mail: Travis Gilskey 406-350-0019 Travis.Gilskey@terracon.com — Sampler Name if other than Contact: Travis Gilskey
Invoice Address: same as above	Invoice Contact and Phone #: Travis Gilskey, 406-350-0019 — Purchase Order #: — ELI Quote #:

Report Required For: POTW/WWTP ☐ DW ☐ Other ______

Special Report Formats - ELI must be notified prior to sample submittal for the following:
NELAC ☐ A2LA ☐ Level IV ☐
Other ______
EDD/EDT ☐ Format ______

ANALYSIS REQUESTED

Notify ELI prior to RUSH sample submittal for additional charges and scheduling

Comments:
H22070674

Shipped by: Fedex Express
Cooler ID(s)
Receipt Temp 23.3 °C
Custody Seal Y N
Intact Y N
Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers / Sample Type: A W S V B O Air / Water Soils/Solids Vegetation / Bioassay Other — MATRIX	pH	Sulfate	SEE ATTACHED	Normal Turnaround (TAT)	RUSH Turnaround (TAT)	LAB ID (LABORATORY USE ONLY)
1 Cody Temple; P-01; 2.5-6.5'	6/16/2022		Soils	✔	✔			✔	
2 Cody Temple; B-05; 5-6.5'	6/16/2022		Soils	✔	✔			✔	
3 Cody Temple; B-06; 5-9'	6/16/2022		Soils	✔	✔			✔	
4									
5									
6									
7									
8									
9									
10									

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Travis Gilskey	7/20/2022	Travis Gilskey		7/20/2022	
Relinquished by: (print)	Date/Time:	Signature:	Received by (print): [illegible signature]	Date/Time: 7/21/22	Signature: [illegible signature]

Sample Disposal: Return to client: ______ Lab Disposal: X

LABORATORY USE ONLY
Sample Type: # of fractions

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontracted data will be clearly annotated on your analytical report.

Visit our website at *www.energylab.com* for additional information, downloadable fee schedule, forms, & links.

Percolation Test

Project:	Cody Temple			Location:	Northeast Corner
Test #:	P1	Hole Depth:	22"	Hole Diameter:	14"
Date:	6/17/2022	Begin Soak:	7:50 AM	End Soak:	8:50 AM

Visual Classification: Poorly Graded Gravel with Silt and Sand (GP-GM)
GPS Coordinates: 44.51214°, -109.08111°

Test Results

			Depth Below Reference Point			
Start Time	End Time	Time Interval (minutes)	Initial (inches)	Final (inches)	Drop in Water Level (inches)	Percolation Rate (minutes/inch)
8:50 AM	9:05 AM	15	16.00	18.25	2.25	6.7
9:05 AM	9:20 AM	15	16.00	18.00	2.00	7.5
9:20 AM	9:35 AM	15	16.00	17.75	1.75	8.6
9:35 AM	9:50 AM	15	16.00	17.75	1.75	8.6

Final Percolation Rate = 8.6 minutes/inch

Percolation Tests are performed in accordance with City of Cody Public Works requirements.

Percolation Test

Project:	Cody Temple			Location:	Southeast Corner
Test #:	P2	Hole Depth:	22"	Hole Diameter:	14"
Date:	6/17/2022	Begin Soak:	7:55 AM	End Soak:	8:55 AM

Visual Classification: Poorly Graded Gravel with Silt and Sand (GP-GM)
GPS Coordinates: 44.51111°, -109.08070°

Test Results

			Depth Below Reference Point			
Start Time	End Time	Time Interval	Initial	Final	Drop in Water Level	Percolation Rate
		(minutes)	(inches)	(inches)	(inches)	(minutes/inch)
8:55 AM	9:10 AM	15	16.00	18.00	2.0	7.5
9:10 AM	9:25 AM	15	16.00	18.00	2.0	7.5
9:25 AM	9:40 AM	15	16.00	17.75	1.75	8.6
9:40 AM	9:55 AM	15	16.00	17.75	1.75	8.6

Final Percolation Rate = 8.6 minutes/inch

Percolation Tests are performed in accordance with City of Cody Public Works requirements.

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Nielson Site ■ Cody, WY

Terracon Project No. 26225020

Terracon GeoReport

SAMPLING

Rock Core

Grab Sample

Split Spoon

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			**BEDROCK**	
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1	< 20	Weathered
Loose	4 - 9	Soft	500 to 1,000	2 - 4	20 - 29	Firm
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8	30 - 49	Medium Hard
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15	50 - 79	Hard
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30	>79	Very Hard
		Hard	> 8,000	> 30		

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			$PI < 4$ or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay [K, L, M, N]; Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay [K, L, M, P]; Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

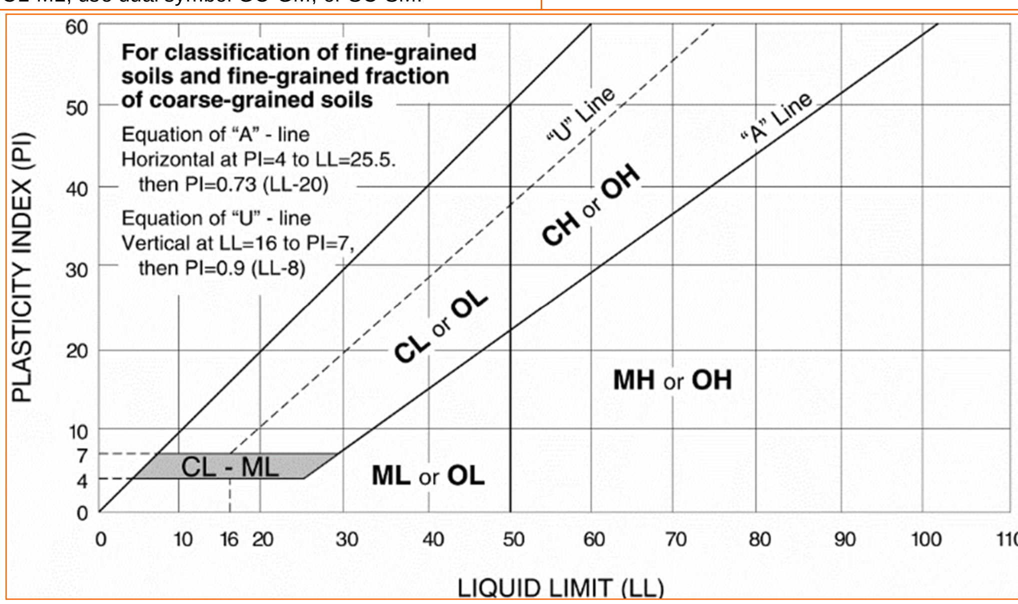
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements